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(NASA-SP-7037(306)) - AERONAUTICAL
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(SUPPLEMENT 306) (NASA) 75 p

N94-35338

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NASA SP-7037 (306)

July 1994

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES



National Aeronautics and Space Administration
Scientific and Technical Information Program
Washington, DC

1994

This publication was prepared by the NASA Center for Aerospace Information,
800 Elkridge Landing Road, Linthicum Heights, MD 21090-2934, (301) 621-0390.

INTRODUCTION

This issue of *Aeronautical Engineering — A Continuing Bibliography with Indexes* (NASA SP-7037) lists 181 reports, journal articles, and other documents recently announced in the NASA STI Database.

Accession numbers cited in this issue include:

Scientific and Technical Aerospace Reports (STAR) (N-10000 Series)

N94-30425 — N94-32419

Open Literature (A-10000 Series)

None in this issue

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the publication consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals.

Seven indexes—subject, personal author, corporate source, foreign technology, contract number, report number, and accession number—are included.

A cumulative index for 1994 will be published in early 1995.

Information on availability of documents listed, addresses of organizations, and CASI price schedules are located at the back of this issue.

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TYPICAL REPORT CITATION AND ABSTRACT

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ACCESSION NUMBER → N94-10675*# National Aeronautics and Space Administration. ← CORPORATE SOURCE
Langley Research Center, Hampton, VA.

TITLE → STATIC INTERNAL PERFORMANCE OF A SINGLE
EXPANSION RAMP NOZZLE WITH MULTIAxis THRUST
VECTORING CAPABILITY

AUTHORS → FRANCIS J. CAPONE and ALBERTO W. SCHIRMER (George
Washington Univ., Hampton, VA.) Washington Jul. 1993 ← PUBLICATION DATE
272 p

CONTRACT NUMBER → (Contract RTOP 505-62-30-01)

REPORT NUMBERS → (NASA-TM-4450; L-17163; NAS 1.15:4450) Avail: CASI HC A12/ ← AVAILABILITY AND
MF A03 PRICE CODE

An investigation was conducted at static conditions in order to determine the internal performance characteristics of a multiaxis thrust vectoring single expansion ramp nozzle. Yaw vectoring was achieved by deflecting yaw flaps in the nozzle sidewall into the nozzle exhaust flow. In order to eliminate any physical interference between the variable angle yaw flap deflected into the exhaust flow and the nozzle upper ramp and lower flap which were deflected for pitch vectoring, the downstream corners of both the nozzle ramp and lower flap were cut off to allow for up to 30 deg of yaw vectoring. The effects of nozzle upper ramp and lower flap cutout, yaw flap hinge line location and hinge inclination angle, sidewall containment, geometric pitch vector angle, and geometric yaw vector angle were studied. This investigation was conducted in the static-test facility of the Langley 16-foot Transonic Tunnel at nozzle pressure ratios up to 8.0.

Author (revised)

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 306)

July 1994

01

AERONAUTICS (GENERAL)

N94-31332# Naval Postgraduate School, Monterey, CA.
**AN ANALYSIS OF THE MAINTENANCE PERFORMANCE
MEASUREMENT SYSTEM FOR LAMPS MK 3 HELICOPTER
SQUADRONS M.S. Thesis**

RICHARD K. FAWCETT Dec. 1993 212 p
(AD-A276421) Avail: CASI HC A10/MF A03

With the current downsizing of the United States military and the defense budget, the diminishing availability of resources has increased the focus on the need for effective management. This thesis discusses several factors affecting performance improvement (effectiveness, efficiency, quality, productivity, budgetability, quality of work life, and innovation) for LAMPS MK 3 helicopter squadrons. Current non-financial measures for monitoring the performance of maintenance are examined and evaluated. Alternative maintenance performance measures are described and discussed. The alternative measures for which source data is available are analyzed. A new performance measurement model, the Multi-Criteria Performance/Productivity Measurement Technique, and the Objectives Matrix, is described and recommended for measuring LAMPS MK 3 helicopter squadron maintenance performance.

DTIC

N94-31362# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
**AN EVALUATION OF AIRCRAFT MAINTENANCE
PERFORMANCE FACTORS IN THE OBJECTIVE WING M.S.
Thesis**

MARK A. GRAY and MARGARET M. RANALLI Sep. 1993 152 p
(AD-A276010; AFIT/GLM/LA/93S-22) Avail: CASI HC A08/MF A02

Prior to 1992, organizational maintenance was aligned under a separate maintenance organization. In 1992, the Air Force restructured into objective wings with organizational maintenance aligned under the flying squadrons. This study looks at the impact of this reorganization on maintenance performance factors. The researchers developed maintenance performance models using regression and principal component analysis. Mission capable rate and total not mission capable maintenance rate are used as dependent variables. A comparison of key maintenance performance indicators and model predictions before and after the reorganization is accomplished. Based on the results of this analysis, the researchers conclude that there is significant improvement in all dependent variables, model predictions of these dependent variables, and some of the independent variables. Improvement occurred after organizational structure changed; however, other factors not included in the models such as the stand-down of the alert force may also contribute to this improvement.

DTIC

N94-31367# Wright Lab., Wright-Patterson AFB, OH.
**THE MAINTENANCE OF OPERATIONAL FLIGHT PROGRAM
Final Report, 5-8 Oct. 1992**

CHARLES P. SATTERTHWAITE Jan. 1994 10 p
(Contract AF PROJ. 9994)

(AD-A276363; WL-TR-94-1009) Avail: CASI HC A02/MF A01

The process of maintaining Operational Flight Programs (OFP's) is discussed so that interested individuals can understand (1) how OFP's work, (2) how OFP's are changed, (3) how OFP's are tested, (4) how OFP's are documented, (5) how to train OFP maintainers, and (6) how to measure OFP's.

DTIC

N94-31830# Robbins-Gioia, Inc., Alexandria, VA.
**INITIAL ESTIMATES OF INTEGRATED MAINTENANCE
INFORMATION SYSTEM (IMIS) COSTS AND BENEFITS, VOLUME
1 Final Report, Jul. - Sep. 1993**

ROBERT J. TOMASETTI, A. B. CALOGERO, CHARLIE E. JONES,
CHARLES L. HANNA, and THOMAS J. GUARINO Oct. 1993
53 p

(Contract F33600-85-D-7002)

(AD-A276144; AL/HR-TR-1993-0178-VOL-1) Avail: CASI HC A04/
MF A01

This report analyzes the system-wide costs and benefits of implementing the Integrated Maintenance Information System (IMIS) for the F-16. The Human Resources Directorate of the Armstrong Laboratory has undertaken IMIS as an Advanced Technology Transition Demonstration (ATTD) effort. ATTD efforts provide proof-of-principle demonstrations conducted at the system or major subsystem level in an operational environment. They demonstrate the potential of new technologies to provide significant improvements in cost-effectiveness. IMIS has the potential to provide major improvements in the efficiency of aircraft maintenance processes. This report documents the initial effort to develop a rough order of magnitude estimate of the functional costs and benefits of implementing the IMIS technology. Estimates are developed for the Base Case and two IMIS implementation alternatives. The alternatives are analyzed, results identified, and conclusions reached.

DTIC

N94-32157# Federal Aviation Administration, Atlantic City, NJ.
Technical Center.

**SHEAROGRAPHIC INSPECTION OF A DEHAVILLAND DHC-7
STEPHEN N. BOBO Dec. 1993 24 p**

(AD-A276716; DOT/FAA/CT-TN92/39) Avail: CASI HC A03/MF
A01

Under a Cooperative Research and Development Agreement between the Volpe National Transportation Systems Center (VNTSC) and Henson Aviation, Inc., operator of US Air Express, a shearographic demonstration inspection of the fuselage of a DeHavilland DHC-7 aircraft was performed at a US Air repair station at Norfolk, VA, on August 8, 1992. The inspection compared the effectiveness of shearography with currently mandated methods in detecting disbands in the fuselage. Adhesive bonding is utilized in modern aircraft fuselages, frequently in combination with rivets. As aircraft age, bond failure becomes a major problem, since it may promote fatigue cracking, moisture intrusion, and subsequent corrosion. Any of these events may cause cabin pressure loss and, sometimes, catastrophic fuselage failure. The shearographic method of detecting disbands depends on the deformation of the aircraft

01 AERONAUTICS (GENERAL)

skin under mechanical stimulus. When illuminated by coherent light, the phase relationship and intensity of the light reflected from any two points of the skin changes as a result of this deformation. Surface changes down to 0.00025 millimeter can be detected and displayed as a real-time image of the field of view. Comparison of successive images as the deformation changes permits interpretation of the condition of a bond. In addition, other selected areas of the aircraft suspected to contain disbonds were inspected. No disbonds were found either by shearography or confirming ultrasound readings. Shearography was clearly able to identify the presence of waffle doublers wherever drawings of the aircraft indicated that they should exist. DTIC

N94-32254# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Human Resources Directorate.

HUMAN COMPUTER INTERFACE SPECIFICATIONS (HCIS) FOR THE INTEGRATED MAINTENANCE INFORMATION SYSTEM (IMIS)

JEFFREY L. WAMPLER, DAVID R. GUNNING, CHER E. WYNKOOP, LAURIE L. QUILL, and LAURA L. MOORMAN Oct. 1993 145 p

(Contract F33615-88-C-0024)

(AD-A277184; AL/HR-TP-1993-0035) Avail: CASI HC A07/MF A02

The Armstrong Laboratory Logistics Research Division (AL/HRG) is developing a proof-of-concept Integrated Maintenance Information System (IMIS). The IMIS will demonstrate the capability to access and integrate maintenance information from multiple sources and present the information to technicians and maintenance personnel through hand-held and workstation computers. A significant part of IMIS is the user interface. Current practices in the DoD procurement process do not emphasize the specification of a system's user interface as requirements. Instead, the user interface is often designed as the system develops. This paper documents a baseline user interface specification for all IMIS applications and a detailed user interface specification for an interactive electronic technical manual (IETM) presentation system. DTIC

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

N94-30492 National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

ASPECTS OF THE MODELING AND NUMERICAL SIMULATION OF LEADING-EDGE VORTEX FLOW

H. W. M. HOEIJMAKERS 4 Dec. 1992 23 p Presented at the IUTAM Symposium on Fluid Dynamics of High Angle of Attack, Tokyo University, Japan, 13-17 Sep. 1992 Sponsored by Netherlands Agency for Aerospace Programs Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(AD-B179108; NLR-TP-92521-U; ETN-94-95965) Avail: CASI HC A03

A cell centered central difference finite volume Euler method is applied to the steady subsonic flow about a 65 degree sharp cropped delta wing at incidences close to the incidence at which leading edge vortex breakdown is observed in wind tunnel experiments. Above a critical value of the incidence the pseudo-time dependent numerical procedure fails to attain a steady state solution. For the case of subsonic leading edge vortex flow the occurrence of 'solution breakdown' indicates the limits of the domain of applicability of the steady flow Euler method. In the search for the critical incidence it is found that for a given grid and for a given setting of the parameters

controlling the artificial dissipation two distinct, steady state solutions exist. Analysis of the two solutions obtained at one incidence reveals that within the vortex core above the aft part of the wing these solutions feature remarkably different velocity and vorticity distributions. ESA

N94-30493 National Aerospace Lab., Amsterdam (Netherlands). Aerodynamics Div.

A RESIDUAL CORRECTION METHOD APPLIED TO 2D MULTI-POINT AIRFOIL DESIGN AND 3D SINGLE-POINT WING DESIGN

T. E. LABRUJERE and J. VANDERVOOREN 31 Jan. 1993 25 p

Submitted for publication Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(Contract AERO-1082)

(NLR-TP-92524-U; ETN-94-95966) Avail: CASI HC A03

Results of a residual correction method to solve the multipoint airfoil design problem for subsonic and transonic conditions are presented. The method is based on full potential theory and minimizes a cost function weighting the deviations from specified target pressure distributions for each design condition in a least squares sense. Deviations from specified target pressure distributions (residuals) are translated into airfoil geometry corrections, by means of an approximate inverse calculation using a linearized panel method. The feasibility of introducing an equivalent incompressible multipoint design problem is demonstrated for a two point reconstruction test case. First results of a two point example airfoil design case are presented. The applicability of the residual correction methodology to three dimensional single point wing design is demonstrated as well. ESA

N94-30525 Virginia Polytechnic Inst. and State Univ., Blacksburg. SENSITIVITY ANALYSIS OF THE STATIC AEROELASTIC RESPONSE OF A WING Ph.D. Thesis

LLOYD BYRON ELDRED 1993 147 p

Avail: Univ. Microfilms Order No. DA9319768

A technique to obtain the sensitivity of the static aeroelastic response of a three dimensional wing model is designed and implemented. The formulation is quite general and accepts any aerodynamic and structural analysis capability. A program to combine the discipline level, or local, sensitivities into global sensitivity derivatives is developed. A variety of representations of the wing pressure field are developed and tested to determine the most accurate and efficient scheme for representing the field outside of the aerodynamic code. Chebyshev polynomials are used to globally fit the pressure field. This approach had some difficulties in representing local variations in the field, so a variety of local interpolation polynomial pressure representations are also implemented. These panel based representations use a constant pressure value, a bilinearly interpolated value, or a biquadratically interpolated value. The interpolation polynomial approaches do an excellent job of reducing the numerical problems of the global approach for comparable computational effort. Regardless of the pressure representation used, sensitivity and response results with excellent accuracy have been produced for large integrated quantities such as wing tip deflection and trim angle of attack. The sensitivities of such things as individual generalized displacements have been found with fair accuracy. In general, accuracy is found to be proportional to the relative size of the derivatives to the quantity itself.

Dissert. Abstr.

N94-30740 National Aerospace Lab., Amsterdam (Netherlands). Unsteady Aerodynamics and Aeroelasticity Dept.

PROSPECTS OF TIME-LINEARIZED UNSTEADY CALCULATION METHODS FOR EXPONENTIALLY DIVERGING MOTIONS IN AEROELASTICITY

M. H. J. HOUNJET and B. J. G. EUSSEN 22 Apr. 1992 21 p

Presented at the AIAA Dynamics Specialist Conference, Dallas, TX, 16-17 Apr. 1992 Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(PB94-126224; NLR-TP-92163; ETN-94-95578) Avail: CASI

HC A03

A demonstration is given of a simple procedure which was used to generate unsteady loads for oscillating wings in a two dimensional and three dimensional subsonic, transonic and supersonic flow for an almost complete range of existing time linearized methods including a method allowing for wind tunnel wall interference. The method transforms real unsteady data obtained for diverging exponential motions of the wind to unsteady complex data for harmonic oscillations by means of fitting the real data by Pade polynomials and using these approximations for harmonic oscillations assuming the analytical continuation is valid. ESA

N94-30858 National Aerospace Lab., Amsterdam (Netherlands). Aerodynamics Div.

GRID ADAPTION IN COMPUTATIONAL AERODYNAMICS

R. HAGMEIJER and K. M. J. DECOCK 1 Apr. 1992 23 p Submitted for publication Sponsored in part by National Aerospace Lab. Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (Contract AERO-0018-C(H)) (PB94-126240; NLR-TP-92139-U; ETN-94-95575) Avail: CASI HC A03

An algorithm to adapt computational grids is applied to aerodynamic problems. The algorithm is described and the main features are discussed. Applications to both inviscid and viscous flows around two dimensional airfoils show that the algorithm is robust and almost fully automatic, and that shocks, expansion zones, boundary layers and shear layers are well resolved by the adapted grid. ESA

N94-30865 Air Force Inst. of Tech., Wright-Patterson AFB, OH. **HOPF BIFURCATION IN VISCOUS, LOW-SPEED FLOWS ABOUT AN AIRFOIL WITH STRUCTURAL COUPLING** Ph.D. Thesis

MARK JOHN LUTTON 1993 152 p
Avail: Univ. Microfilms Order No. DA9324933

The locations of Hopf bifurcation points associated with the viscous incompressible flow about a NACA 0012 airfoil with structural coupling are computed for very low Reynolds numbers (less than 2000). A semi-implicit, first-order-accurate time-integration algorithm is employed to solve the streamfunction-vorticity form of the Navier-Stokes equations. The formulation models the inclusion of simple structural elements affixed to the airfoil and captures the resulting airfoil motion. The equations describing the airfoil motion are integrated in time using a fourth-order Runge-Kutta algorithm. The dissertation is divided into two parts. In Part I, numerical experiments are performed in the laminar regime to determine if the structural model of the airfoil has an effect upon the location of the Hopf bifurcation point when compared with the fixed airfoil. Results are reported for a variety of structural characteristics, including variation of torsional and linear spring constants, inertial properties, structural coupling, and structural damping. The structure of the solution space is explored by means of phase plots. In Part II, the Baldwin-Lomax turbulence model is implemented to model turbulent flow. A numerical effort is made to predict the onset of unsteady flow and the results are compared to theory and experiment. A comparison is undertaken with the compressible and incompressible form of the Navier-Stokes equations to assess the correspondence of the unsteady lift evolved by pitching the airfoil at a prescribed frequency and amplitude. Comparisons are made with the lift predicted by the potential flow method of Theodorsen. Dissert. Abstr.

N94-30871 National Aerospace Lab., Amsterdam (Netherlands). Theoretical Aerodynamics Dept.

NUMERICAL SIMULATION OF LEADING-EDGE VORTEX FLOW

H. W. M. HOEIJMAKERS (Technische Univ., Eindhoven, Netherlands.) 30 Nov. 1991 31 p Sponsored by Netherlands Agency for Aerospace Programs, and Ministry of Defence Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-B175154; PB94-125481; NLR-TP-91471-U; ETN-94-95568)

Avail: CASI HC A03

An analysis of results of a computational method to simulate the steady compressible vortical type of flow around a 65 deg sharp edged cropped delta wing is presented. Some more fundamental aspects of the numerical simulation such as the separation of the flow, the structure of the leading edge vortex core and the flow inside the free shear layer are emphasized. For the vortex core in isolation as well as for the free shear layer, closed form solutions are presented which might assist in the analysis of the numerical results. ESA

N94-30916# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

AERODYNAMIC ANALYSIS OF SLIPSTREAM/WING/NACELLE INTERFERENCE FOR PRELIMINARY DESIGN OF AIRCRAFT CONFIGURATIONS

C. M. VANBEEK, W. J. PIERS, and B. OSKAM 22 Nov. 1991 25 p Presented at the AGARD Fluid Dynamics Panel Symposium on Aerodynamic Engine/Airframe Integration for High Performance Aircraft and Missiles, Fort Worth, TX, 7-10 Oct. 1991 Sponsored by Netherlands Agency for Aerospace Programs (AD-B173651; NLR-TP-91453; ETN-94-95567) Avail: CASI HC A03/MF A01

A panel method based model for the computation of the time averaged influence of a propeller slipstream on the aerodynamic characteristics of an aircraft configuration is described. The slipstream model is based on the simplifications that the single rotating propeller is replaced by an actuator disk and that all the vorticity of the slipstream is represented on a cylindrical sheet of fixed geometry which envelops the slipstream in combination with a discrete vortex at the axis of the slipstream. Appropriate jump conditions across the actuator disk and boundary conditions on the cylindrical sheet, solved simultaneously with the boundary conditions on the aircraft configuration, yield the mutual influence of the propeller and the slipstream on the aerodynamic characteristics of the aircraft. This slipstream model is incorporated in a three dimensional panel method. Computed lift increments due to the slipstream are presented for a realistic wing/nacelle/fuselage configuration and compared with wind tunnel data for several thrust coefficients and angles of attack of the aircraft. ESA

N94-30949#* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

EVALUATION OF FLIP-FLOP JET NOZZLES FOR USE AS PRACTICAL EXCITATION DEVICES

GANESH RAMAN (NYMA, Inc., Brook Park, OH.), EDWARD J. RICE, and DAVID M. CORNELIUS Apr. 1994 13 p Proposed for presentation at the ASME Fluids Engineering Division Summer Meeting, Lake Tahoe, NV, 19-23 Jun. 1994; sponsored by ASME (Contract NAS3-27186; RTOP 505-62-52) (NASA-TM-106377; E-8190; NAS 1.15:106377) Avail: CASI HC A03/MF A01

This paper describes the flowfield characteristics of the flip-flop jet nozzle and the potential for using this nozzle as a practical excitation device. It appears from the existing body of published information that there is a lack of data on the parameters affecting the operation of such nozzles and on the mechanism of operation of these nozzles. An attempt is made in the present work to study the important parameters affecting the operation and performance of a flip-flop jet nozzle. Measurements were carried out to systematically assess the effect of varying the nozzle pressure ratio (NPR) as well as the length and volume of the feedback tube on the frequency of oscillation of this device. Flow visualization was used to obtain a better understanding of the jet flowfield and of the processes occurring within the feedback tube. The frequency of oscillation of the flip-flop jet depended significantly on the feedback tube length and volume as well as on the nozzle pressure ratio. In contrast, the coherent velocity perturbation levels did not depend on the above mentioned parameters. The data presented in this paper would be

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useful for modeling such flip-flop excitation devices that are potentially useful for controlling practical shear flows. Author

N94-31180 National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

CFD-BASED DRAG PREDICTION: STATE-OF-THE-ART, THEORY, PROSPECTS

J. VANDERVOOREN and J. W. SLOOFF 15 Sep. 1992 75 p
Presented at the AIAA Professional Studies Series, Course on Drag Prediction and Measurement, Portland, OR, 23-24 Aug. 1990 Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-B179297; NLR-TP-90247-U; ETN-94-95974) Avail: CASI HC A04

An overview of the state of the art and the theory of Computational Fluid Dynamics (CFD) based drag prediction, with some emphasis on transport aircraft, is presented. The entire field, ranging from potential codes to Reynolds averaged Navier-Stokes codes is covered. Only steady flow, in the absence of propulsion, is discussed. It is concluded that, although CFD based drag prediction can be viewed with 'cautious optimism', it still has a long way to go; research and development in CFD post processing routines for drag prediction purposes is required for many years to come. ESA

N94-31204 Rensselaer Polytechnic Inst., Troy, NY.

AN ADAPTIVE FINITE ELEMENT METHOD FOR UNSTEADY COMPRESSIBLE ROTOR AIRFOIL AERODYNAMICS Ph.D. Thesis

BRUCE EUGENE WEBSTER 1993 199 p
Avail: Univ. Microfilms Order No. DA9325276

The accurate treatment of unsteady compressible rotor airfoil aerodynamic flows requires the capability to efficiently resolve the widely varying length scales of the flow physics as they evolve temporally. An adaptive finite element methodology suitable for this type of problem is developed in this thesis. It is based upon an automated adaptive environment consisting of the Finite Quadtree automatic mesh generator, a time-discontinuous Galerkin Least Squares finite element flow solver, an error indicator based upon interpolation estimates, and a mesh enrichment procedure. The time-discontinuous Galerkin Least Squares finite element flow solver is particularly well suited to handle problems with multiple relative motion. A linear space-time wedge element formulation was developed and implemented which is suitable for two dimensional problems with relative body motion. The mesh enrichment procedure developed to enable the solution process to be spatially adaptive (h-refinement) is edge based and stores no mesh enrichment history. Steady and unsteady transonic airfoil calculations show good correlation with other experimental and numerical data. Based upon these results it is concluded that this type of automated adaptive CFD technique is a viable computational tool capable of accurately resolving unsteady compressible flow features and should be developed further to handle three dimensional problems where multiple relative motion is important, i.e. the flow field around an entire helicopter. Dissert. Abstr.

N94-31216 Michigan Univ., Ann Arbor.

CONTROL OF HYPERSONIC AERODYNAMIC FORCES WITH SURFACE BLOWING Ph.D. Thesis

MICHAEL DAVID MATARRESE 1993 156 p
Avail: Univ. Microfilms Order No. DA9319582

Aerodynamic forces are obtained for laminar flow past a slender wedge at high Mach number and high Reynolds number, with a cool inert gas injected at the surface. Mass-flow rates are taken to be large enough to blow the boundary layer away from the wall as a free shear layer, but small enough that the effective body remains thin. Cases studied include distributed blowing where the wall mass flux is proportional to a power of the streamwise coordinate, uniform blowing from a strip located downstream from the wedge vertex, and various examples of time-dependent mass injection. For power-law blowing, self-similar solutions are obtained

in the strong- and weak-interaction limits for the layer of blown gas adjacent to the surface, for the viscous shear layer, and for the outer inviscid-flow region between the shear layer and the shock wave. Formulas are derived which relate the surface pressure and surface shear stress to the mass flow, and the behavior of the pressure force and drag are examined for a range of parameter values, for different injectants, and for various distributions of the injected mass. Equilibrium dissociation of oxygen and other real-gas effects are included in part of the analysis. For strip blowing on a cool wall, mass flows are chosen such that the flow separates upstream of the slot leading edge in a hypersonic free interaction. The pressure force as a function of mass-flow rate is obtained for various slot geometries, including an example with two slots. For unsteady distributed blowing, time histories of the pressure force are computed for various cases where the shear layer may be neglected and the time rate of change of the wall boundary conditions is small compared to the residence time in the outer flow. Dissert. Abstr.

N94-31220# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.

PREDICTION OF TRANSONIC POTENTIAL FLOW WITH SLIPSTREAMS AROUND CONFIGURATIONS

WANG DIEQIAN and SVEN G. HEDMAN Feb. 1993 58 p Sponsored by Aeronautical Research Inst. of Sweden
(Contract NUTEK-5623-92-01540)

(FFA-TN-1992-15; ETN-94-95879) Avail: CASI HC A04/MF A01

A potential flow code was developed for the simulation of transonic flow around wing/body/nacelle configurations and for the prediction of propeller/airframe interference. The propeller is modeled as an actuator disk, and the effect of the slipstream is considered in an approximate way. The wing/body/nacelle flow solver and the grid generator were developed from earlier codes for wing/body cases. The computational space is divided into two blocks, with one block inboard and one outboard of the nacelle. The algorithm for the two block case is fully implicit not only in all the three coordinate directions but also between the two blocks. It is uniformly stable for all regions in the field. The method uses almost the same CPU (Central Processing Unit) time as the one block solver does for wing/body configurations. Hence, it is a very robust algorithm and the method is cost effective. Applications are shown for three cases simulating propeller driven airplanes in subsonic climb and transonic cruise. Comparisons are made with data from Euler code calculations and also with results from wind tunnel tests. In general the obtained agreement is very good. ESA

N94-31287 Old Dominion Univ., Norfolk, VA.

GRID SENSITIVITY FOR AERODYNAMIC OPTIMIZATION AND FLOW ANALYSIS Ph.D. Thesis

IDEEN SADREHAGHIGHI 1993 119 p
Avail: Univ. Microfilms Order No. DA9319038

An algorithm is developed to obtain the grid sensitivity with respect to design parameters for aerodynamic optimization. Two distinct parameterization procedures are developed for investigating the grid sensitivity with respect to design parameters of a wing section as an example. The first procedure is based on traditional (physical) relations defining NACA four-digit wing sections. The second is advocating a novel (geometrical) parameterization using spline functions such as NURBS (nonuniform rational b-splines) for defining the wing section geometry. An interactive algebraic grid generation technique, known as two-boundary grid generation (TBGG), is employed to generate C-type grids around wing sections. The grid sensitivity of the domain with respect to design and grid parameters has been obtained by direct differentiation of the grid equations. A hybrid approach is proposed for more geometrically complex configurations. A comparison of the sensitivity coefficients with those obtained using a finite difference approach is made to verify the feasibility of the approach. The aerodynamic sensitivity coefficients are obtained using the compressible, two dimensional, thin-layer Navier-Stokes equations. An optimization package has been introduced into the algorithm in order to optimize the wing

section surface using both physical and geometric parameterization. Results demonstrate a substantially improved design, particularly in the geometric parameterization case. Dissert. Abstr.

N94-31421# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

EXPERIMENTAL AND NUMERICAL SIMULATION OF HELICOPTER ROTOR FUSELAGE INTERACTION Ph.D. Thesis - Aix-Marseille Univ. [SIMULATION EXPERIMENTALE ET NUMERIQUE DE L'INTERACTION ROTOR-FUSELAGE D'HELICOPTERE]

ROLAND HANOTEL 1993 141 p In FRENCH Original contains color illustrations (ISSN 0078-3781)

(ONERA-NT-1993-8; ETN-94-96063) Avail: CASI HC A07/MF A02

A Computational Fluid Dynamics (CFD) method for prediction of helicopter/fuselage interactions is proposed. The main rotor blades are modeled using lifting line theory, with the rotor wake discretized using a lattice of radial and tangential elements. The fuselage is modeled by a surface distribution of sources and doublets. The interaction is computed by balancing out iteratively the influence of the rotor and that of the fuselage. The latter was analyzed by means of isolated rotor and coupled fuselage/rotor computations. Induced velocities from two different data banks were used to validate this method. ESA

N94-31578# Sandia National Labs., Albuquerque, NM.

A NOVEL CFD/STRUCTURAL ANALYSIS OF A CROSS PARACHUTE

R. A. LAFARGE, J. M. NELSEN, and K. W. GWINN 1993 11 p Presented at the 32nd Aerospace Sciences Meeting and Exhibit, Reno, NV, 11-14 Jan. 1994

(Contract DE-AC04-94AL-85000)

(DE94-005271; SAND-93-3895C; CONF-940152-1) Avail: CASI HC A03/MF A01

A novel CFD/structural analysis was performed to predict functionality of a cross parachute under loadings near the structural limits of the parachute. The determination of parachute functionality was based on the computed structural integrity of the canopy and suspension lines. In addition to the standard aerodynamic pressure loading on the canopy, the structural analysis considered the reduction in fabric strength due to the computed aerodynamic heating. The intent was to illustrate the feasibility of such an analysis with the commercially available software PATRAN. DOE

N94-31734# Toronto Univ. (Ontario). Dept. of Aerospace Science and Engineering.

HEAVE DYNAMICS OF AN AIR CUSHION VEHICLE BAG AND FINGER SKIRT M.S. Thesis

JOON CHUNG 1993 114 p

(ISBN-0-315-87053-2; CTN-94-61242) Copyright Avail: Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

A theoretical analysis of the heave dynamics of an air cushion vehicle bag and finger skirt is presented. The dynamic response of the skirt was predicted using a simplified model derived from Lagrange's equations. The skirt mass is lumped in the finger, and the fingers are modelled as rigid bodies having both mass and moment of inertia. The equations governing the dynamics of the bag and finger system and its interaction with cushion and craft systems are then derived. The theoretical model uses a simplified geometry and has two degrees of freedom. It is further developed to explore its ability to predict dynamic skirt responses. A system of nonlinear differential equations is solved by integration using Gear's method. The assumptions related to the fluid mechanics, skirt material properties, and skirt geometry used in the analysis are presented and the reasons for their choice are discussed. The theoretical results of the nonlinear heave response and the effect of both the skirt mass and changing skirt geometry on frequency response are detailed. Simulation results show that though air cushion dynamics

are nonlinear as a whole, there are distinct segments which may be predicted by linear analysis. Author (CISTI)

N94-31759 Colorado Univ., Boulder.

NUMERICAL SIMULATION OF COMBINED EXTERNAL/INTERNAL TRANSONIC FLOW ON THE FOREBODY/INLET OF THE AV-8B HARRIER 2 Ph.D. Thesis

STEPHEN JOHN MYSKO, III 1993 117 p

Avail: Univ. Microfilms Order No. DA9320457

In this work, the computation of combined external/internal transonic flow on the complex forebody/inlet configuration of the AV-8B Harrier 2 is performed. The actual aircraft has been measured and its surface and surrounding domain have been defined using computational structured grids. The thin-layer Navier-Stokes equations were used to model the flow along with the Chimera overlaid multiblock technique. A fully conservative, alternating direction implicit (ADI), approximately-factored (two factors), partially flux-split algorithm was employed to perform the computation. Comparisons to some experimental data yielded good agreement for the simplifications incorporated into the analysis. The aim of the dissertation is to provide a methodology or computational tool for the numerical solution of complex flows, specifically combined external/internal flows. The use of embedded multiblocks enables easier definition of the geometry and also allows for single surfaces to be defined by more than one grid. The unique grid system must account for a geometry which has a fuselage and inlet which share a wall, and at the same time be able to model both external and internal flow. An existing code was altered to conform with the needs of the study, and a special boundary condition was developed and is presented. This boundary condition was used near the inlet engine face to improve the accuracy of the numerical model. The algorithm incorporates the Chimera technique and an algebraic turbulence model in order to deal with the overlaid multiblocks and viscous governing equations. The TFFS (two-factor, flux-split) scheme was applied to solve steady flows using the CRAY Y-MP supercomputer. The general flow quality was discussed and evaluated and any problem areas were expanded upon. The results for flow at zero incidence and angle of attack compared favorably with the experimental data both for local surface pressure data and globally over the entire engine face. In addition, the inlet back pressure boundary condition was employed to generate off-design flow characteristics. The results indicate the methodology used here is a viable tool for aircraft modeling. Dissert. Abstr.

N94-31822# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.

ON AN ADAPTATION METHOD FOR 2-DIMENSIONAL C-TYPE GRIDS

P. W. J. VANHENGEL and M. A. VIS 1993 12 p Presented at ISNaS Symposium, Emmeloord, Netherlands, 19-20 Sep. 1991 Prepared in cooperation with National Aerospace Lab.

(W-9322; ETN-94-96183) Avail: CASI HC A03/MF A01

A practical application of an adaptive grid method for two dimensional C type grids around aerofoils is presented. The method was applied to adapt grids used for the simulation of inviscid flow (NACA 0012 aerofoil) and viscous flow (RAE 2822 aerofoil). It is concluded that the method is very well suited for grids with moderate aspect ratios as used for inviscid flow computations. High aspect ratio grids, as used for viscous flow computations, require more careful tuning of the parameters in the adaptation algorithm. ESA

N94-31828 Colorado Univ., Boulder.

A NEW INVERSE METHOD FOR GENERATING HIGH-SPEED AERODYNAMIC FLOWS WITH APPLICATION TO WAVERIDER DESIGN Ph.D. Thesis

KEVIN DANIEL JONES 1993 172 p

Avail: Univ. Microfilms Order No. DA9320435

The design of efficient high-speed aircraft is of considerable interest for use in a multitude of applications including civil transport,

access to low earth orbit, and aeroassisted orbital transfer. The design of such vehicles is often accomplished with the aid of numerical methods. A new, numerical inverse-design method is developed for the principle lifting surface of such vehicles. Here the compressible three dimensional Euler equations are marched spatially away from a prescribed shock surface in a cross-stream direction to define the post-shock flowfield. The general three dimensional problem is mathematically ill-posed; however, by marching within the local osculating plane, accurate and stable solutions are obtained. The algorithm is applied to the design of a class of hypersonic vehicles called waveriders. The waverider's lower surface is defined as a stream surface carved from the post-shock flowfield computed by this marching procedure. The waverider's upper surface is a parametrically defined expansion surface, and the flowfield there is predicted by an approximation of the axisymmetric method of characteristics. Comparisons with exact theory and direct Euler simulations demonstrate the validity and accuracy of the method. The algorithm's application to waverider design affords much greater flexibility in the choice of shock shapes than any previous studies, including here the possibility of nonaxisymmetric shocks with nonconstant shock strengths. Dissert. Abstr.

**N94-31879 Texas Univ., Arlington.
SHOCK IMPINGEMENT NEAR HYPersonic EXPANSION
CORNERS Ph.D. Thesis**

KUNG-MING CHUNG 1992 151 p
Avail: Univ. Microfilms Order No. DA9315977

Experiments were performed in the UTA shock tunnel at Mach 8 and a Reynolds number of 10.2 million/m. A cold-wall, turbulent boundary layer developed along a long flat plate installed in the test section. An expansion corner of 2.5 deg or 4.25 deg was located at 0.77 meters (30.25 inches) from the leading edge of the flat plate. The test surface was instrumented for surface pressure measurement using flush-mounted, fast-response pressure transducers. Interactions were generated by full-span external shock generation in the form of a 2 deg or 4 deg sharp wedge. A hypersonic similarity parameter was identified which scaled the downstream influence of an expansion corner, indicating that the flow can be treated as primarily rotational and inviscid. The surface pressure fluctuations were severely damped by the expansion. The pressure distributions with shock impingement were strongly influenced by the presence of the expansion corners. The upstream influence scale decreased as the shock impinged further downstream of the corner. The unsteadiness of the shock wave/boundary layer interactions was characterized by an intermittent region together with a local rms pressure peak near the upstream influence line. Also, the peak rms pressure fluctuations increased with a larger overall inviscid pressure ratio. Dissert. Abstr.

**N94-31880 Ohio State Univ., Columbus.
DESIGN AND INITIAL TESTING OF A FACILITY TO MEASURE
UNSTEADY PRESSURES ON AN OSCILLATING CASCADE WITH
SUPERSONIC LEADING EDGE LOCUS Ph.D. Thesis**

DANIEL EUGENE ERWIN 1993 156 p
Avail: Univ. Microfilms Order No. DA9316150

The development of analytical codes to predict the lift and moment coefficients on an airfoil in an oscillating cascade with a supersonic leading edge locus (SLEL) has generated a need to obtain unsteady experimental pressure data to validate the codes. A facility to gather such data was designed and constructed at the Ohio State University Aeronautical and Astronautical Research Laboratory, and unsteady pressure data was collected for a cascade oscillating at zero stagger angle. Unsteady pressures were measured for reduced frequencies ranging from .025 (26 Hz) to .159 (166 Hz), based on half chord. An experimental influence coefficient technique originally developed for subsonic and transonic cascades was extended to the case of a cascades with a SLEL. This technique was developed to obtain the unsteady pressure difference coefficient on an airfoil in a cascade of airfoils, all of which were executing constant amplitude oscillations at a constant interblade phase angle. This influence coefficient technique allowed the measure-

ment of the pressures by oscillating one airfoil at a time. In order to extend the influence coefficient technique to the measurement of unsteady pressures on a cascades with a SLEL, it was first necessary to derive the equations applicable to a SLEL cascade. The unsteady pressure on a reference airfoil due to all of the airfoils oscillating was then the sum of the influence coefficients from each airfoil. Dissert. Abstr.

**N94-31882 North Carolina State Univ., Raleigh.
BOUNDARY LAYER STUDY ON NOZZLE WALL AT HYPersonic
VELOCITIES Ph.D. Thesis**

KENNETH MORRIS JONES 1993 151 p
Avail: Univ. Microfilms Order No. DA9316605

The boundary layer on the wall of Naval Surface Warfare Center (NSWC) Hypervelocity Tunnel 9 has been investigated with pitot pressure and total temperature measurements. Experimental results are presented for standard Mach 14 runs and supercooled Mach 14 and Mach 18 runs. The experimental results are compared to numerical predictions made with a modified Navier-Stokes algorithm including vibrational nonequilibrium and intermolecular force effects. The code uses the Cebeci-Smith turbulence model, which has real gas terms incorporated, to model the boundary layer. For standard Mach 14 conditions, the numerical solutions agree very well with experimental data. For the supercooled cases, the numerical code predicts the total temperature well; however, it overpredicts the pitot pressure. In all cases, the turbulence model significantly underestimated the boundary layer thickness and displacement thickness. A study of the method of characteristics/boundary layer technique to design hypersonic nozzles was also carried out. A Mach 18 nozzle was designed with this method and analyzed with the same Navier-Stokes code used to analyze the experimental data. The numerical analysis revealed that the nozzle generated a uniform, disturbance free core flow. Dissert. Abstr.

**N94-31907 California Inst. of Tech., Pasadena.
TIP EFFECTS ON THE VORTEX WAKE OF AN AXISYMMETRIC
BODY AT ANGLE OF ATTACK Ph.D. Thesis**

DAVID HENRY BRIDGES 1993 186 p
Avail: Univ. Microfilms Order No. DA9316833

Experiments on the effects of conditions at the tip of an axisymmetric body on the vortex wake of the body at large angle of attack in incompressible flow have been performed. The separation patterns that occur at the nose of a cone with a hemispherical tip have been documented for ranges of Reynolds number based on tip radius and of relative angle of attack. Tips with cross sections that vary smoothly from elliptic to circular have been designed and tested on a cone. The effectiveness of the tips in varying the cone side force coefficient as the tip is rotated has been demonstrated. The relation between tip roll angle and side force coefficient has been shown to be essentially independent of Reynolds number, for the range of Reynolds number tested, as well as cone base conditions and roll direction. The relation between tip roll angle and side force coefficient has been shown to be a strong function of angle of attack. The reasons for nonsmooth variation of side force coefficient with tip roll angle at higher angles of attack have been determined by examinations of the vortex wake geometry. Peaks in the magnitude of the side force coefficient after zero crossings have been shown to be caused by a rapid shift in the wake vortices away from a symmetric configuration as the tip rotates away from a symmetry condition. Reductions in magnitude of the side force coefficient between magnitude peaks have been demonstrated to be a result of the near vortex crossing over the cone centerline. This vortex crossover has been shown to occur near and after the breakaway from the cone of the far vortex. The ability of one of the elliptic cross section tips to produce smooth variations of side force coefficient with roll angle ahead of vortex breakaway has been demonstrated, suggesting that the tip might be an effective yaw control device for aircraft at high angle of attack. Dissert. Abstr.

**N94-31958 Stanford Univ., CA.
VIBRATIONAL ENERGY TRANSFER OF DIATOMIC GASES IN**

HYPersonic EXPANDING FLOWS Ph.D. Thesis

STEPHEN MERRICK RUFFIN 1993 196 p

Avail: Univ. Microfilms Order No. DA9326551

In high temperature flows related to vehicles at hypersonic speeds significant excitation of the vibrational energy modes of the gas can occur. Accurate predictions of the vibrational state of the gas and the rates of vibrational energy transfer are essential to achieve optimum engine performance, for design of heat shields, and for studies of ground based hypersonic test facilities. The Landau-Teller relaxation model is widely used because it has been shown to give accurate predictions in vibrationally heating flows such as behind forebody shocks. However, a number of experiments in nozzles have indicated that it fails to accurately predict the rate of energy transfer in expanding, or cooling, flow regions and fails to predict the distribution of energy in the vibrational quantum levels. The present study examines the range of applicability of the Landau-Teller model in expanding flows and develops techniques which provide accurate predictions in expanding flows. In the present study, detailed calculations of the vibrational relaxation process of N₂ and CO in cooling flows are conducted. A coupled set of vibrational transition rate equations and quasi one dimensional fluid dynamic equations is solved. Rapid anharmonic vibration translation transition rates and vibration-vibration exchange collisions are found to be responsible for vibrational relaxation acceleration in situations of high vibrational temperature and low translational temperature. The predictions of the detailed master equation solver are in excellent agreement with experimental results. The exact degree of acceleration is cataloged in this study for N₂ and is found to be a function of both the translational temperature (T) and the ratio of vibrational to translational temperatures ($T(\text{sub vib})/T$). Non-Boltzmann population distributions are observed for values of $T(\text{sub vib})/T$ as low as 2.0. The local energy transfer rate is shown to be an order of magnitude or more faster than the Landau-Teller model for more extreme cases of thermal nonequilibrium. However, these large degrees of local acceleration are difficult to observe in gas dynamic flows because the vibrational energy becomes frozen in rapid expansions. The Landau-Teller model fails to predict non-Boltzmann population distributions for even moderate degrees of thermal nonequilibrium but only fails to accurately predict the overall amount energy in vibration for flows which both have high values of $T(\text{sub vib})/T$ and are not vibrationally frozen. A simplified relaxation model is developed which allows both non-Boltzmann population distributions and includes anharmonic transition rates and energy transfer. Although the simplified anharmonic model requires significantly less computational time than the master equation solver it gives good agreement with the detailed solver and with experimental test results.

Dissert. Abstr.

N94-31971 Notre Dame Univ., IN.**A STUDY OF THE DEVELOPMENT AND ATTENUATION OF WING-GENERATED, VORTICAL WAKES Ph.D. Thesis**

VOJIN RADE NIKOLIC 1993 255 p

Avail: Univ. Microfilms Order No. DA9319292

Lift-generated wake vortices trailing behind present-day heavy aircraft are of great concern to the aviation community, because they can pose a hazard to a following aircraft that inadvertently penetrates the wake. In order to address the problem of wake-vortex alleviation in a systematic way, an inviscid three dimensional model for calculation of the roll up of wing vortex wakes was developed. The code was extensively tested and validated using a large body of theoretical, computational, and experimental results. During the validation, it was shown that the second moment of vorticity, heretofore assumed to be constant, not only changes as the wake evolves, but must do so in order to conserve energy. Further, the second moment of vorticity has been shown to be a reliable measure of the completeness of the wake roll up process. Found efficient and reliable, the computer code has been applied to computationally investigate some alleviation schemes suggested in the literature as well as some original concepts. It was demonstrated that tailoring the wing spanwise load distribution by use of flaps modifies the resulting wake in terms of making it both more diffuse and, by

mooring the primary vortices closer together, renders it more susceptible to the 'Crow' far field instability. Although injection of counter-rotating (with respect to the wing tip vortex) vortices showed little merit, injection of corotating discrete midspan vortices both changes the roll up pattern and hastens the far field instability (from a separation point of view), but causes induced drag penalties. As a completely new idea, excitation of the far field instability of the main wing-vortex pair by injecting relatively weak, intermediate-span, discrete vortices was investigated. During the course of this last investigation, a new method of determining the character of vortex entrainment was developed and shown to be viable. The result of this excitation investigation showed that injection of single, relatively weak, corotating discrete vortices near 0.5 semispans on the left and right side of the wing effectively excited the far field, most-unstable wavelength. The optimal wing location for vortex injection was shown to be only weakly dependent on vortex strength. These findings appear to be compatible with some experimental results from the literature, although the authors of the article containing these results offer an alternative explanation for the mechanism responsible for their results. In fact, the work of this dissertation shows that the alternative explanation appears to be incorrect. Additionally, in an unrelated investigation performed as part of this dissertation research, it was confirmed that the wake roll up can be disorganized by implementing positive bound-circulation gradients near wing tips; however, this benefit was offset by high drag and weight penalties.

Dissert. Abstr.

N94-32027 George Washington Univ., Washington, DC.**SHOCK-DEPENDENT, OPTIMUM THRUST WINGS IN SUPERSONIC FLOW Ph.D. Thesis**

JAMES LEE PITTMAN 1993 141 p

Avail: Univ. Microfilms Order No. DA9318335

This study proposes a new wing concept that reduces the inviscid drag of a wing in supersonic flow. This wing concept contours the surface of each streamwise airfoil aft of the maximum thickness location to produce a significant thrust force thereby reducing the inviscid drag of the wing. The effectiveness of the thrust-wing concept is dependent upon the occurrence of a secondary shock on the wing surface. The secondary shock is clearly identified and exploited herein for the first time. The thrust-wing concept was evaluated on delta wing planforms and compared with delta wings using modified NACA 4-digit airfoils at $M(\text{sub infinity}) = 1.60$. The basic wing camber surface is a spanwise circular arc. The primary figure of merit for the evaluation was the inviscid drag coefficient as computed by a full-potential flow solver for supersonic flow, NCOREL. A design procedure was developed to calculate a feasible, optimum thrust wing at a specified Mach number and lift coefficient for a given planform. The optimization algorithm was the Method of Feasible Directions as found in the CONMIN program. The optimization for a 60 degree delta wing at $M(\text{sub infinity}) = 1.60$ yielded a thrust wing with 17 percent lower inviscid drag at $CL = 0.1$ compared to the corresponding wing that utilized a modified NACA 4-digit airfoil. At $C(\text{sub L}) = 0.3$, a 9 percent inviscid drag reduction was obtained.

Dissert. Abstr.

N94-32063*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.**A CRITICAL ASSESSMENT OF UH-60 MAIN ROTOR BLADE AIRFOIL DATA**

JOSEPH TOTAH Sep. 1993 24 p Presented at the 11th Annual Applied Aerodynamics Meeting, Monterey, CA, 9-13 Aug. 1993 See also A93-47210

(Contract RTOP 505-59-36)

(NASA-TM-103985; A-93004; NAS 1.15:103985) Avail: CASI HC A03/MF A01

Many current comprehensive rotorcraft analyses employ lifting-line methods that require main rotor blade airfoil data, typically obtained from wind tunnel tests. In order to effectively evaluate these lifting-line methods, it is of the utmost importance to ensure that the airfoil section data are free of inaccuracies. A critical assessment of the SC1095 and SC1094R8 airfoil data used on the

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UH-60 main rotor blade was performed for that reason. Nine sources of wind tunnel data were examined, all of which contain SC1095 data and four of which also contain SC1094R8 data. Findings indicate that the most accurate data were generated in 1982 at the 11-Foot Wind Tunnel Facility at NASA Ames Research Center and in 1985 at the 6-inch by 22-inch transonic wind tunnel facility at Ohio State University. It has not been determined if data from these two sources are sufficiently accurate for their use in comprehensive rotorcraft analytical models of the UH-60. It is recommended that new airfoil tables be created for both airfoils using the existing data. Additional wind tunnel experimentation is also recommended to provide high quality data for correlation with these new airfoil tables.

Author (revised)

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AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

N94-30890 National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Technology Lab.

REMOTE SENSOR OBSERVATIONS DURING WISP91: THE USE OF MICROWAVE RADIOMETERS, RASS, AND LIDAR CEILOMETERS FOR DETECTION OF AIRCRAFT ICING CONDITIONS

B. B. STANKOV, J. B. SNIDER, E. R. WESTWATER, R. H. BEELER, and L. S. FEDOR Oct. 1993 85 p See also PB91-131839 Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(PB94-142106; NOAA-TM-ERL-ETL-236) Avail: CASI HC A05

From Jan. 15 through Mar. 31, 1991, the National Oceanic and Atmospheric Administration's (NOAA) Wave Propagation Laboratory (WPL) participated in the Winter Icing and Storms Project (WISP91). Several remote sensors were used in the study: an array of four dual-channel microwave radiometers, Wind Profilers and Radio Acoustic Sounding Systems (RASS) at 915, 405, and 50 MHz; operational National Weather Service (NWS) lidar ceilometers; and infrared radiometers operating at 10.6 micrometers. One of the principal objectives of the project was to determine the utility of combined sensors to detect supercooled liquid water. After describing the changes in the system relative to the 1990 experiments, results of two representative cases are presented to illustrate the capabilities and limitations of the combined system. NTIS

N94-31230# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

DEVELOPMENT OF A THREE-DIMENSIONAL ICING MODEL FOR PREDICTING ICE ACCRETION ON AIRCRAFT Ph.D.

Thesis - Clermont-Ferrand II Univ. [MODELISATION TRIDIMENSIONNELLE DES DEPOTS DE GIVRE SUR LES VOILURES D'AERONEFS]

THIERRY HEDDE 1993 148 p In FRENCH (ISSN 0078-3781)

(ONERA-NT-1993-5; ETN-94-95874) Avail: CASI HC A07/MF A02

The development of a three dimensional icing code is described. Nonviscous flows may be calculated using either the Euler method, especially in the transonic domain, or the panel method, mainly for multistep ice accretion calculations. A Van Driest roughness model was implemented in the turbulent boundary layer calculation, and yields realistic values of the heat transfer coefficient. The estimation of the runback equation terms shows that the air/water interface shear stress is the leading one. A new grid built up along the runback paths can be used to establish the thermodynamic balance and calculate the ice thickness. The qualities of the model at high velocities (150 to 300 m/s) can be seen by comparison of the simulated ice shapes with the experimental shapes obtained on a parabolic rotor blade tip. Comparison with 'lobster tails' ice shapes grown on a swept NACA 0012 airfoil at low speed (70 m/s)

shows the model's limits. The 'lobster tails' accretion is explained by way of droplet scale shadowing phenomena, and by local variation of the heat transfer coefficient. A ballistic model simulates the lobster tail accretion well, although only qualitatively, due to lack of experimental data. ESA

N94-31246# Galaxy Scientific Corp., Pleasantville, NJ.

ROTORCRAFT DITCHINGS AND WATER-RELATED IMPACTS THAT OCCURRED FROM 1982 - 1989, PHASE 2 Final Report

MARK MULLER and LINDLEY W. BARK Oct. 1993 43 p

(Contract DTFA03-89-C-00043)

(AD-A276473; DOT/FAA/CT-92/14) Avail: CASI HC A03/MF A01

This report documents Phase II of a two-phase effort to examine rotorcraft ditchings and water-related impacts for rotorcraft, that occurred between the years 1982 through 1989. The main tasks performed for this phase of the investigation were assessment of the effects of structure on occupant injury, determination of the specific modes of structural failure, identification of the potential means to alleviate injury, and evaluation of available analytical methods for modeling rotorcraft water impacts. The Phase II analysis examined specific aspects of the Phase I data for accidents that fulfilled the criteria for the three impact scenarios. The main impact injuries were from flailing and excessive acceleration and resulted from occupant interaction with the rotorcraft interior and insufficient energy absorption. Drowning and exposure were found to be the main post-impact hazards and other post-impact injuries were minor in severity. Structural failures of the rotorcraft are identified and discussed as they affected occupant injury. The performance and adequacy of rotorcraft flotation equipment is discussed. Means of alleviating occupant injury in rotorcraft water impacts are identified and discussed. An analytical method for modeling the water impact of a rotorcraft is evaluated. DTIC

N94-31678# Gates Learjet Corp., Wichita, KS.

AIRCRAFT ICING HANDBOOK (UPDATE) Final Report

1993 436 p Revised Sponsored by FAA

(AD-A276499) Avail: CASI HC A19/MF A04

The first update of the Aircraft Icing Handbook does not change the organization of the handbook into volumes and chapters as delineated on page 7. However, new sections have been added to Chapter 3: ice protection methods. Section 1.0 no longer contains information on pneumatic impulse deicing and has therefore been retitled: Section 1.0 - Conventional pneumatic boot deicing systems. Three new sections have been added: Section 1A.0 - pneumatic impulse deicing systems; Section 4A.0 - electro-explosive deicing systems; and Section 4B.0 - eddy current deicing systems. DTIC

N94-31803* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

WHIPICE (Videotape)

1992 Videotape: 8 min. 30 sec. playing time, in color, with sound (NASA-TM-109749; NONP-VT-94-9949) Avail: CASI VHS A01/BETA A22

This video documents efforts by NASA Lewis Research Center researchers to improve ice protection for aircraft. A new system of deicing aircraft by allowing a thin sheet of ice to develop, then breaking it into particles, is being examined, particularly to determine the extent of shed ice ingestion by jet engines that results. The process is documented by a high speed imaging system that scans the breakup and flow of the ice particles at 1000 frames per second. This data is then digitized and analyzed using a computer program called WHIPICE, which analyzes grey scale images of the ice particles. Detailed description of the operation of this computer program is provided. CASI

N94-31902 Communications Research Centre, Ottawa (Ontario). Mobile Satellite Communications.

SATCOM FEASIBILITY STUDY FOR SEARCH AND RESCUE AIRCRAFT Final Report

JOHN SYDOR and JACK RIGLEY Jan. 1993 131 p

(DSIS-94-01083; CTN-94-61214) Avail: CASI HC A07/MF A02

The feasibility of using satellite communications to improve the reliability of communications to search and rescue (SAR) aircraft throughout the Canadian SAR regions is examined. The primary satellite communications media considered are MSAT and Inmarsat. The main communications requirement for SAR aircraft operations is reliable voice communications throughout the SAR regions. Secondary or desirable requirements include global operations and security of voice and data communication. Both Inmarsat and MSAT systems were found capable of meeting the prime requirement. The differences between those two systems is most evident in the avionics and antennas required to access them. Inmarsat equipment is much larger and more expensive than the equivalent MSAT equipment, since the MSAT system (to become operational by 1995) will be more powerful and sensitive. However, MSAT aeronautical satcom terminals are not yet available and would have to be developed, most likely as a derivative of MSAT land mobile terminals. Analysis of Satcom installations for CC-130 and CH-113 SAR aircraft was completed for both Inmarsat and MSAT compatible avionics and antennas. Most currently available Inmarsat compatible equipment is feasible for the CC-130, while only the smaller sized MSAT antenna is feasible for the CH-113. Author (CISTI)

N94-32168# Industrial Coll. of the Armed Forces, Washington, DC.

A COMPARISON OF MILITARY AND COMMERCIAL AIRCRAFT DEVELOPMENT Report, Aug. 1992 - Apr. 1993

MICHAEL S. MUTTY Apr. 1993 37 p
(AD-A276830; NDU/ICAF-93-F3) Avail: CASI HC A03/MF A01

When compared to the commercial sector, it takes the military almost four times longer to develop an aircraft. For example, Boeing Company developed the 767 jetliner in about four years whereas the Navy's next generation tactical aircraft, the AX, is expected to take 15 years to develop. This research paper examines both commercial and military approaches to aircraft development. The paper focuses on establishing whether or not commercial practices, where more cost effective, can be incorporated into the military acquisition system. The paper illustrates that aircraft development in the commercial and military are different for two fundamental reasons. First, military aircraft development exploits the latest untested developments in technology where the commercial sector relies only on existing technologies. Second, a commercial aircraft is developed for the single mission of ferrying passengers and cargo. Military aircraft are required to perform far more varied and different missions with each parameter driving its own unique challenge for design and testing. This research paper concludes that without similar mission requirements, there are few commercial applications that can be applied to military aircraft development. DTIC

N94-32363# Army Aeromedical Research Lab., Fort Rucker, AL.
ESTIMATING THE IMPACT OF CRASHWORTHINESS STANDARDS ON MORTALITY AND MORBIDITY EVENTS IN THE US ARMY ROTARY-WING AIRCRAFT MISHAPS Final Report

SAMUEL G. SHANNON and DENNIS F. SHANAHAN Sep. 1993 49 p

(Contract DA PROJ. 3M1-62787-A-878)
(AD-A277121; USAARL-93-37) Avail: CASI HC A03/MF A01

It is desirable to provide modern military helicopters with the maximum crashworthiness that is practical in order to reduce injury in helicopter crashes. Although crashworthy design features have been proven to be extremely effective in reducing morbidity and mortality, a penalty of increased weight and added procurement cost must be paid. Consequently, the degree of crashworthiness designed into an aircraft must be a tradeoff between economics, aircraft performance, and the perceived risk of injury. To help these judgments, it would be useful to develop a mathematical model capable of predicting morbidity outcomes for a given aircraft design. All crashes of five types of U.S. Army helicopters occurring between 1 Oct. 1979 and 30 Sep. 1991 were examined to determine crash conditions and morbidity and mortality outcomes. Analyses were

conducted with logistic regression (LOGISTIC) for mortality, and the fit of the model was considered. DTIC

N94-32405 Naval Research Lab., Washington, DC.

GLUTINOUS WATER: PROTECTING VERTICAL AND OVERHEAD SURFACES FROM FIRE SPREAD

HOMER W. CARHART 28 Feb. 1994 12 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(AD-A277280; NRL/MR/6180-94-7431) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

Most of the water used in firefighting is not only wasted, it also contributes extensively to total damage. Water is an unusual chemical in that, due to hydrogen bonding, it is a liquid at room temperature and it also has a very high heat of evaporation. So, if one could make water adhere significantly to vertical and overhead surfaces, a great deal of fire protection could be bought because such surfaces could not get hotter than the boiling point of water (100 C) and a great deal of heat energy would be required to evaporate it. This can be accomplished by making water glutinous, either by making a foam (e.g. shaving cream) or by thickening it (e.g. gravy), or both. Calculations and experiment show that up to at least ten times greater fire protection could be achieved with only about 1/20 to 1/50 the amount of water. DTIC

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

N94-30439 National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

A SIMULATOR FOR MULTI-RADAR ANALYSIS FOR REALISTIC TRAFFIC

R. A. HOGENDOORN, F. HEEREMA, and P. SAUER 12 Jan. 1992 19 p Presented at the Workshop on RASS, Eurocontrol Institute, Luxembourg, 14-16 Dec. 1992 Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-B179099; NLR-TP-92481-U; ETN-94-95964) Avail: CASI HC A03

An overview of the SMART (Simulator for Multiradar Analysis for Realistic Traffic) radar simulator is given. A generic simulator model is presented and the two major subsystems of SMART, the Traffic Subsystem (TSS) and the Radar Subsystem (RSS) are described. Software engineering aspects are discussed and samples of test results are presented in order to show the simulator operation. ESA

N94-30643*# Air Force Systems Command, Falcon AFB, CO.
AN OPERATIONAL CONTROL SEGMENT (OCS) UPDATE ON GPS CONSTELLATION STATUS AND FUTURE PROGRAM DIRECTIONS

HARRISON C. FREER In NASA. Goddard Space Flight Center, The 25th Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 65-78 May 1994

Avail: CASI HC A03/MF A06

An update on what is going on with the Global Positioning System (GPS) is presented. The performance of the GPS is covered, and the Federal Radionavigation Plan is discussed.

Derived from text

N94-30644*# Coast Guard, Washington, DC.

LORAN-C TIME MANAGEMENT

CHARLES JUSTICE, NORM MASON, and DOUG TAGGART In NASA. Goddard Space Flight Center, The 25th Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 79-92 May 1994

Avail: CASI HC A03/MF A06

As of 1 Oct. 1993, the US Coast Guard (USCG) supports and operates fifteen Loran-C chains. With the introduction of the Global Positioning Systems (GPS) and the termination of the Department of Defense (DOD) overseas need for Loran-C, the USCG will cease operating the three remaining overseas chains by 31 Dec. 1994. Following this date, the USCG Loran-C system will consist of twelve chains. Since 1971, management of time synchronization of the Loran-C system has been conducted under a Memorandum of Agreement between the US Naval Observatory (USNO) and the USCG. The requirement to maintain synchronization with Coordinated Universal Time (UTC) was initially specified as ± 25 microseconds. This tolerance was rapidly lowered to ± 2.5 microseconds in 1974. To manage this synchronization requirement, the USCG incorporated administrative practices which kept the USNO apprised of all aspects of the master timing path. This included procedures for responding to timing path failures, timing adjustments, and time steps. Conducting these aspects of time synchronization depended on message traffic between the various master stations and the USNO. To determine clock adjustment the USCG relied upon the USNO's Series 4 and 100 updates so that the characteristics of the master clock could be plotted and controls appropriately applied. In 1987, Public Law 100-223, under the Airport and Airway Improvement Act Amendment, reduced the synchronization tolerance to approximately 100 nanoseconds for chains serving the National Airspace System (NAS). This action caused changes in the previous administrative procedures and techniques. The actions taken by the USCG to meet the requirements of this law are presented. Author (revised)

N94-30648*# Bureau International des Poids et Mesures, Sevres (France).

GPS COMMON-VIEW TIME TRANSFER

W. LEWANDOWSKI In NASA. Goddard Space Flight Center, The 25th Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 133-148 May 1994

Avail: CASI HC A03/MF A06

The introduction of the GPS common-view method at the beginning of the 1980's led to an immediate and dramatic improvement of international time comparisons. Since then, further progress brought the precision and accuracy of GPS common-view intercontinental time transfer from tens of nanoseconds to a few nanoseconds, even with SA activated. This achievement was made possible by the use of the following: ultra-precise ground antenna coordinates, post-processed precise ephemerides, double-frequency measurements of ionosphere, and appropriate international coordination and standardization. This paper reviews developments and applications of the GPS common-view method during the last decade and comments on possible future improvements whose objective is to attain sub-nanosecond uncertainty. Author (revised)

N94-30650*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

TIME AND POSITION ACCURACY USING CODELESS GPS

C. E. DUNN, D. C. JEFFERSON, S. M. LICHTEN, J. B. THOMAS, Y. VIGUE, and L. E. YOUNG In NASA. Goddard Space Flight Center, The 25th Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 169-182 May 1994

Avail: CASI HC A03/MF A06

The Global Positioning System has allowed scientists and engineers to make measurements having accuracy far beyond the original 15 meter goal of the system. Using global networks of P-Code capable receivers and extensive post-processing, geodesists have achieved baseline precision of a few parts per billion, and clock offsets have been measured at the nanosecond level over intercontinental distances. A cloud hangs over this picture, however. The Department of Defense plans to encrypt the P-Code (called Anti-Spoofing, or AS) in the fall of 1993. After this event, geodetic and time measurements will have to be made using codeless GPS receivers. However, there appears to be a silver lining to the cloud.

In response to the anticipated encryption of the P-Code, the geodetic and GPS receiver community has developed some remarkably effective means of coping with AS without classified information. We will discuss various codeless techniques currently available and the data noise resulting from each. We will review some geodetic results obtained using only codeless data, and discuss the implications for time measurements. Finally, we will present the status of GPS research at JPL in relation to codeless clock measurements.

Author (revised)

N94-30651*# Bureau International des Poids et Mesures, Sevres (France).

THE USE OF THE AOA TTR-4P GPS RECEIVER IN OPERATION AT THE BIPM FOR REAL-TIME RESTITUTION OF GPS TIME

CLAUDINE THOMAS In NASA. Goddard Space Flight Center, The 25th Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 183-196 May 1994

Avail: CASI HC A03/MF A06

The Global Positioning System is an outstanding tool for the dissemination of time. Using mono-channel C/A-code GPS time receivers, the restitution of GPS time through the satellite constellation presents a peak-to-peak discrepancy of several tens of nanoseconds without SA but may be as high as several hundreds of nanoseconds with SA. As a consequence, civil users are more and more interested in implementing hardware and software methods for efficient restitution of GPS time, especially in the framework of the project of a real-time prediction of UTC (UTCp) which could be available in the form of time differences (UTCp - GPS time). Previous work, for improving the real-time restitution of GPS time with SA, to the level obtained without SA, focused on the implementation of a Kalman filter based on past data and updated at each new observation. An alternative solution relies upon the statistical features of the noise brought about by SA; it has already been shown that the SA noise is efficiently reduced by averaging data from numerous satellites observed simultaneously over a sufficiently long time. This method was successfully applied to data from a GPS time receiver, model AOA TTR-4P, connected to the cesium clock kept at the BIPM. This device, a multi-channel, dual frequency, P-code GPS time receiver, is one of the first TTR-4P units in operation in a civil laboratory. Preliminary comparative studies of this new equipment with conventional GPS time receivers are described in this paper. The results of an experimental restitution of GPS time, obtained in June 1993, are also detailed: 3 to 6 satellites were observed simultaneously with a sample interval of 15 s, an efficient smoothing of SA noise was realized by averaging data on all observed satellites over more than 1 hour. When the GPS system is complete in 1994, 8 satellites will be observable continuously from anywhere in the world and the same level of uncertainty will be obtained using a shorter averaging time. Author (revised)

N94-30652*# Hydro-Electric Power Commission, Burnaby (British Columbia).

DEVELOPMENT OF AN ACCURATE TRANSMISSION LINE FAULT LOCATOR USING THE GLOBAL POSITIONING SYSTEM SATELLITES

HARRY LEE In NASA. Goddard Space Flight Center, The 25th Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 197-204 May 1994

Avail: CASI HC A02/MF A06

A highly accurate transmission line fault locator based on the traveling-wave principle was developed and successfully operated within B.C. Hydro. A transmission line fault produces a fast-risetime traveling wave at the fault point which propagates along the transmission line. This fault locator system consists of traveling wave detectors located at key substations which detect and time tag the leading edge of the fault-generated traveling wave as it passes through. A master station gathers the time-tagged information from the remote detectors and determines the location of the fault. Precise time is a key element to the success of this system. This fault locator system derives its timing from the Global Positioning System (GPS) satellites. System tests confirmed the accuracy of locating

faults to within the design objective of ± 300 meters.

Author (revised)

N94-30655*# Graz Univ. (Austria).

TROPOSPHERIC CORRECTIONS TO GPS MEASUREMENTS USING LOCALLY MEASURED METEOROLOGICAL PARAMETERS COMPARED WITH GENERAL TROPOSPHERIC CORRECTIONS

D. KIRCHNER, C. LENTZ, and H. RESSLER *In* NASA. Goddard Space Flight Center, The 25th Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 231-248 May 1994

Avail: CASI HC A03/MF A06

At the Technical University Graz (TUG), Austria, the Global Positioning System (GPS) has been used for time transfer purposes since the early 80's and from that time on local meteorological parameters have been recorded together with each measurement (satellite track). The paper compares the tropospheric corrections (delays) obtained from models usually employed in GPS receivers and those using locally measured meteorological parameters.

Author (revised)

N94-30660*# National Inst. of Standards and Technology, Boulder, CO. Time and Frequency Div.

A COMPARISON OF GPS BROADCAST AND DMA PRECISE EPHEMERIDES

MARC A. WEISS, GERARD PETIT, and STEVE SHATTIL *In* NASA. Goddard Space Flight Center, The 25th Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 293-306 May 1994

Avail: CASI HC A03/MF A06

We compare the broadcast ephemerides from Global Positioning Satellites (GPS) to the postprocessed ephemerides from the Defense Mapping Agency (DMA). We find significant energy in the spectrum of the residuals at 1 cycle/day and higher multiples. We estimate the time variance of the residuals and show that the short term residuals, from 15 min, exhibit power law processes with greater low frequency perturbations than white phase modulation. We discuss the significance of these results for the performance of the GPS Kalman filter which estimates the broadcast orbits.

Author

N94-30661*# Beijing Inst. of Radio Metrology and Measurements (China).

SOME APPLICATIONS OF GPS TIMING INFORMATION

YINBAI ZHANG *In* NASA. Goddard Space Flight Center, The 25th Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 307-315 May 1994

Avail: CASI HC A02/MF A06

GPS Satellites transmit two independent signals. One is C/A code (course acquisition signal) which could be utilized by all civilian users. This service is called a Standard Positioning Service (SPS). Another is P code (precise signal) that could be only accessed by those authorized users. The service is called a precise positioning service (PPS). SPS C/A code users can navigate with accuracy of approximately 100 m and timing accuracy of about 250-300 ns (1 sigma). Such timing accuracy is not enough for precision time and frequency value transfer. For this reason we must do some research work to improve the SPS C/A code accuracy which SPS users can get. This paper presents our recent progress on timing information analysis, its data processing and its timing and frequency measurement applications.

Derived from text

N94-30662*# Naval Observatory, Washington, DC.

A COMPARISON OF SEVERAL GPS DATA REDUCTION METHODS

H. CHADSEY *In* NASA. Goddard Space Flight Center, The 25th Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 317-328 May 1994

Avail: CASI HC A03/MF A06

For several years, discussions have been ongoing about how

to analyze GPS time information in order to get the most accurate and precise time comparison between two locations. Many similar studies were done several years ago before the constellation was dominated by Block II satellites. With the Block II satellites and the use of Selective Availability (S/A), time comparisons have lost some precision and accuracy. This paper presents the results of research that was performed to find not only the best of several time comparison methods, but also to determine to what degree precision and accuracy have declined due to S/A.

Author

N94-30663*# Rockwell International Corp., Colorado Springs, CO. **CESIUM AND RUBIDIUM FREQUENCY STANDARDS STATUS AND PERFORMANCE ON THE GPS PROGRAM**

M. J. VANMELLE *In* NASA. Goddard Space Flight Center, The 25th Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 329-344 May 1994

Avail: CASI HC A03/MF A06

This paper is an update of the on-orbit operational performance of the frequency standards on the Block I GPS 8 to 11 Navstar satellites, the Block II GPS 13 to 21 Navstar satellites and the Block IIA GPS 22 to 40 Navstar satellites. A brief history of the frequency standards depicting improvements incorporated in the GPS Program with corresponding results will be presented. The frequency standards configurations from the start to the present, including the various Block IIA clock configurations will be discussed. Topics such as clock observations and long term trending analysis which could enhance on-orbit performance analysis will be covered.

Author

N94-30665*# Bureau International des Poids et Mesures, Sevres (France).

COMPARISON OF LASSO AND GPS TIME TRANSFERS

W. LEWANDOWSKI, G. PETIT, F. BAUMONT, P. FRIDELANCE, J. GAIGNEBET, P. GRUDLER, C. VEILLET, J. WIANT, and W. J. KLEPCZYNSKI *In* NASA. Goddard Space Flight Center, The 25th Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 357-366 May 1994

Avail: CASI HC A02/MF A06

The LASSO is a technique which should allow the comparison of remote atomic clocks with sub-nanosecond precision and accuracy. The first successful time transfer using LASSO has been carried out between the Observatoire de la Cote d'Azur in France and the McDonald Observatory in Texas, United States. This paper presents a preliminary comparison of LASSO time transfer with GPS common-view time transfer.

Author

N94-30677*# Osborne (Allen) Associates, Westlake Village, CA. **IONOSPHERIC CORRECTIONS TO PRECISE TIME TRANSFER USING GPS**

ROBERT W. SNOW, ALLEN W. OSBORNE, III, JOHN A. KLOBUCHAR, and PATRICIA H. DOHERTY *In* NASA. Goddard Space Flight Center, The 25th Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 495-504 May 1994

Avail: CASI HC A02/MF A06

The free electrons in the earth's ionosphere can retard the time of reception of GPS signals received at a ground station, compared to their time in free space, by many tens of nanoseconds, thus limiting the accuracy of time transfer by GPS. The amount of the ionospheric time delay is proportional to the total number of electrons encountered by the wave on its path from each GPS satellite to a receiver. This integrated number of electrons is called Total Electron Content, or TEC. Dual frequency GPS receivers designed by Allen Osborne Associates, Inc. (AOA) directly measure both the ionospheric differential group delay and the differential carrier phase advance for the two GPS frequencies and derive from this the TEC between the receiver and each GPS satellite in track. The group delay information is mainly used to provide an absolute calibration to the relative differential carrier phase, which is an extremely precise measure of relative TEC. The AOA Mini-Rogue ICS-4Z and the AOA TurboRogue ICS-4000Z receivers normally operate using the GPS P code, when available, and switch to cross-correlation

signal processing when the GPS satellites are in the Anti-Spoofing (A-S) mode and the P code is encrypted. An AOA ICS-Z receiver has been operated continuously for over a year at Hanscom AFB, MA to determine the statistics of the variability of the TEC parameter using signals from up to four different directions simultaneously. The 4-channel ICS-4Z and the 8-channel ICS-4000Z, have proven capabilities to make precise, well calibrated, measurements of the ionosphere in several directions simultaneously. In addition to providing ionospheric corrections for precise time transfer via satellite, this dual frequency design allows full code and automatic codeless operation of both the differential group delay and differential carrier phase for numerous ionospheric experiments being conducted. Statistical results of the data collected from the ICS-4Z during the initial year of ionospheric time delay in the northeastern U.S., and initial results with the ICS-4000Z, will be presented.

Author

N94-30853 National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

A STOCHASTIC CONTROL APPROACH TO FLIGHT PATH MONITORING

B. A. VANDOORN and H. A. P. BLOM 31 Jan. 1992 99 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(AD-B174630; NLR-TP-92020-U; ETN-94-95570) Avail: Issuing Activity (European Space Agency (ESA))

A stochastic control approach used to obtain an idea of the qualitative aspects of flight path monitoring is described and first results achieved with it are reported. Two kinds of stochastic control are dealt with: stochastic impulse control and stochastic continuous control. For the latter one, a LQG problem formulation (a Linear model under Gaussian noise with a Quadratic cost function) is considered. For this type of problem formulation, the optimal control is known. A number of experiments are executed to illustrate the optimal control for a simple flight path monitoring problem. The results of these experiments, in combination with the analytical results from impulse control theory, provide a sound basis for the design of a flight path monitoring tool.

ESA

N94-30854 National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

A REVIEW OF THE STATUS AND CAPABILITIES OF NAVSTAR GPS

N. VANDRIEL 10 Feb. 1992 12 p Presented at the Netherlands Institute of Navigation Navstar Global Positioning System Workshop, Amsterdam, Netherlands, 27 Sep. 1991 Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(AD-B174629; PB94-126281; NLR-TP-92042-U; ETN-94-95571) Avail: CASI HC A03

A general description of the Navstar Global Positioning System (GPS) is given. A technical description of the space segment, control segment, and user segment is also given. The program history and present status are recalled. The system performance is evaluated considering the levels of service, precise positioning service, and standard positioning service. Implications related to the possible use of GPS as an operational navigation system are discussed. In order for the system to be used as an operational navigation system for mariners or aviators, it is required that certain criteria for availability, accuracy and integrity are met. Some evolving new techniques are discussed: differential GPS, dynamic carrier tracking, and attitude determination.

ESA

N94-30915 National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

FLIGHT SIMULATOR EVALUATION OF ADVANCED MLS PROCEDURES

L. J. J. ERKELENS and J. H. VANDRONKELAAR 29 Nov. 1991 201 p Sponsored by FAA, and Rijksluchtvaartdienst Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(AD-B174270; NLR-TP-91446-U; ETN-94-95566) Avail: CASI HC A10

Simulator testing, conducted to collect and analyze crew performance and crew response in order to address several issues on equipment failures, is reported. The testing provided both quantitative measures such as aircraft positional errors, aircraft state and control parameters, and qualitative data such as responses to pilot questionnaires and pilot comments. The specific objectives of the present tests are: to expose crews, while flying a moving base flight simulator programmed with the flying qualities of a wide body transport aircraft, to Microwave Landing Systems (MLS) based curved path approach and departure procedures which have been found to be beneficial from an air traffic control point of view; to collect pilot perception and performance data while flying these curved path procedures; to measure crew ability to detect insidious failures and to respond to these failures; to measure crew performance and to collect perception data when the crew must revert to basic MLS position awareness data in the presence of a navigation or guidance failure; to evaluate performance on a complex approach path with one (critical) engine inoperative.

ESA

N94-30933# Civil Aeromedical Inst., Oklahoma City, OK. MAINTAINING VIGILANCE ON A SIMULATED ATC MONITORING TASK ACROSS REPEATED SESSIONS Final Report

D. J. SCHROEDER, R. M. TOUCHSTONE, J. A. STERN, N. STOLIAROV, and R. THACKRAY Mar. 1994 13 p Prepared in cooperation with Massachusetts Inst. of Tech., Cambridge (Contract DTFA02-90-R-00149)

(DOT/FAA/AM-94/6) Avail: CASI HC A03/MF A01

Maintaining alertness to information provided visually is an important aspect of air traffic controllers' work. Improper or incomplete scanning and monitoring behavior is often referred to as one of the causal factors associated with operational errors and deviations. This study was undertaken to assess changes in vigilance/attention across 3 separate days as subjects performed on an Air Traffic Control (ATC) simulation task. Information was gathered as part of a larger study of attention and 'gaze control inefficiencies.' Twenty paid subjects on 3 separate days monitored a simulated ATC task for 44 critical events over a 2 hour session. The complex monitoring task included the detection of: (1) altitude malfunctions; (2) aircraft conflict/no conflicts where 2 aircraft were at the same altitude on an airway simultaneously; and (3) triangular targets representing VFR aircraft that appeared either centrally or peripherally on the screen during the course of each session. Changes in performance on the complex monitoring task associated with either time-on-task or repeated sessions were dependent on nature of the task. Performance on the component involving detection and decision-making (conflict/no conflict detection) evidenced a decrement associated with time-on-task on each of the 3 days. Improvement was evident from the first to the third day. Performance on the identification of the altitude malfunctions remained relatively immune to the effects of time-on-task or repeated sessions. Detection of the VFR aircraft intruders presented a mixed picture, with improvement noted in some aspects of performance but not in others, and some evidence of time-on-task effects. Outcomes were generally consistent with previous findings with this task and consistent with other literature with respect to the presence of performance decrements associated with time-on-task. The results were consistent with a view that the decrements are associated with lapses in attention or 'blocks,' rather than a generalized fatigue effect or a general modification in overall scanning behavior. Furthermore, the results suggest that there were aspects of monitoring performance that remain relatively immune to time-on-task effects, even during the course of the three 2-hour sessions.

Author

N94-30943 National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

THE EXPERIMENTAL FLIGHT MANAGEMENT SYSTEM: AN AIR TRAFFIC MANAGEMENT RESEARCH TOOL

JOB BRUEGGEN 29 Jun. 1992 14 p Presented at the 1992 SFTE Annual Symposium on Flight Testing in the Global Environment,

Long Island, NY, 3-7 Aug. 1992 Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (NLR-TP-92253-U; ETN-94-95972) Avail: CASI HC A03

The Experimental Flight Management System (EFMS) program, part of a European collaborative research program called PHARE (Program for Harmonized ATM (Air Traffic Management) Research in Eurocontrol), which aims to investigate a future ATM scenario, is described. The EFMS will incorporate some revolutionary features, of which the most important are to plan and fly a four dimensional trajectory and to negotiate that trajectory via a digital data link with air traffic control. Development is a multinational activity of the aerospace centers of Germany, France, England and the Netherlands, coordinated by Eurocontrol. A first demonstration is planned for Jan. 1993. A number of applications of the EFMS program are described, most notably the avionic research test bed.

ESA

N94-31080# Army Topographic Engineering Center, Fort Belvoir, VA.

RESULTS OF REAL-TIME TESTING AND DEMONSTRATION OF THE US ARMY CORPS OF ENGINEERS REAL-TIME ON-THE-FLY POSITIONING SYSTEM

SALLY L. FRODGE, BENJAMIN W. REMONDI, and DARIUSZ LAPUCHA Feb. 1994 12 p (AD-A276160; TEC-R-215) Avail: CASI HC A03/MF A01

The U.S. Army Corps of Engineers has been developing a GPS carrier phase based positioning system for hydrographic surveying and dredging since 1988. This system provides real-time three dimensional positions with horizontal and vertical accuracies better than one decimeter over ranges up to 20 kilometers from a single reference station without static initialization. The project has passed from concept development through feasibility studies, system analysis, resolution of carrier ambiguities on-the-fly (OTF), and on to final system integration. The real-time testing of the system began in Mar. of 1993 and public demonstrations of the system began in Oct. 1993. Testing of the system has been performed under varying operating conditions to evaluate the limits of OTF ambiguity resolution for precisely positioning moving platforms. Tests have shown that this system is capable of 1-3 centimeters in all three dimensions. This paper will discuss the results of the testing to date and briefly describe the OTF system.

DTIC

N94-31306# Sandia National Labs., Albuquerque, NM.
AN INVESTIGATION OF AIRBORNE GPS/INS FOR HIGH ACCURACY POSITION AND VELOCITY DETERMINATION

H. SUN (Calgary Univ., Alberta.), M. E. CANNON (Calgary Univ., Alberta.), T. E. OWEN, and M. A. MEINDL 1993 9 p Presented at the Institute of Navigation National Technical Meeting, San Diego, CA, 24-26 Jan. 1994

(Contract DE-AC04-94AL-85000)

(DE94-006139; SAND-93-2413C; CONF-940158-1) Avail: CASI HC A02/MF A01

An airborne test using a differential GPS-INS system in a Twin Otter was conducted by Sandia National Laboratories to assess the feasibility of using the integrated system for cm-level position and cm/s velocity. The INS is a miniaturized ring-laser gyro IMU jointly developed by Sandia and Honeywell while the GPS system consists of the NovAtel GPSCard (trademark). INS position, velocity and attitude data were computed using Sandia's SANDAC flight computer system and logged at 4 Hz and GPS data was acquired at a 1 Hz rate. The mission was approximately 2.5 hours in duration and the aircraft reached separations of up to 19 km from the base station. The data was post-processed using a centralized Kalman filter approach in which the double differenced carrier phase measurements are used to update the INS data. The INS position is in turn used to detect and correct GPS carrier phase cycle slips and also to bridge GPS outages. Results are presented for the GPS-only case and also for integrated GPS/INS.

DOE

N94-31680 Federal Aviation Administration, Cambridge, MA.
FLIGHT TECHNICAL ERROR FOR CATEGORY B NON-

PRECISION APPROACHES AND MISSED APPROACHES USING NON-DIFFERENTIAL GPS FOR COURSE GUIDANCE Final Report, Apr. 1992 - Mar. 1993

M. S. HUNTLEY, J. W. TURNER, and R. PALMER Nov. 1993 67 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (PB94-142734; DOT-VNTSC-FAA-93-17; DOT/FAA/RD-93/17) Avail: CASI HC A04

The report documents and discusses the performance of twelve general aviation pilots who used nondifferential global positioning system (GPS) in a Beechcraft Baron to fly 93 category B approaches defined by GPS waypoints. The research reported here was part of the U.S. Federal Aviation Administration (FAA) GPS Overlay Project and provided the data required by the agency to implement phase 1 of the GPS satellite operational plan for category B nonprecision approaches. The data collection and analysis procedures described herein were developed with and approved by the FAA's Satellite Operations Implementation Team. It should be noted, however, that additional work would be required to prepare the data for use in the development of GPS TERPS.

NTIS

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

N94-30516 Maryland Univ., College Park.
EXPANDING THE WAVERIDER DESIGN SPACE USING ARBITRARY GENERATING FLOWFIELDS Ph.D. Thesis

FREDERICK FERGUSON 1993 227 p
Avail: Univ. Microfilms Order No. DA9327413

The present analysis deals with a quantum leap in the design space of hypersonic vehicles by carefully constructing aircraft from arbitrary flowfields. The design philosophy followed is basically that of finding a shape with a theoretically known and acceptable flowfield in the cruise condition. The ultimate goal is to obtain a complete aircraft configuration with integrated lift surface, stowage volume and propulsion unit, which will have satisfactory low speed, low supersonic speed and cruise Mach number performance. In order to construct shapes, whose behavior in an inviscid fluid stream may be calculated exactly, stream surfaces chosen according to certain rules from assumed shock shapes are replaced by solid boundaries. A combination of such a stream surface, coupled with reliable engineering approximations for the calculations of local shear stress and pressure distribution, are built up piecemeal into complete aircraft configurations. To accomplish the task of designing waveriders a new numerical technique is developed. This numerical method uses the speed and simplicity of spatial marching techniques and the efficiency of the method of characteristics. It is shown that the design process is greatly simplified. Furthermore, this method is sufficiently flexible to allow for considerable freedom of choice in the disposition of lift, volume, and base and platform shapes. Included in this analysis are methods which indicate how the lifting efficiencies of the resulting vehicles may be investigated, and to some extent, optimized. Emphasis is placed on the influence of the shock wave shape and its relationship with the aerodynamic characteristics of the resulting waverider. A systematic approach, based on the Rosenbrock optimization routine, is developed in an effort to carved waveriders with optimal aerodynamic characteristics for given dimension and free stream conditions. A new class of viscous optimized waveriders, possessing very high L/D ratios, are presented. Finally, since the present method provides a very rapid computational procedure, it is used in parametric studies to provide preliminary data on the off design and high altitude performance of waverider configurations.

Dissert. Abstr.

N94-30687 Lawrence Livermore National Lab., CA.
DUAL-BAND INFRARED IMAGING FOR QUANTITATIVE

CORROSION DETECTION IN AGING AIRCRAFT

N. K. DELGRANDE Nov. 1993 5 p Presented at the Autumn Conference of the American Society for Nondestructive Testing (ASNT), Long Beach, CA, 8-12 Nov. 1993 Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(Contract W-7405-ENG-48)

(DE94-004187; UCRL-JC-115167; CONF-931193-1) Avail: CASI HC A01/MF A01

Aircraft skin thickness-loss from corrosion has been measured using dual-band infrared (DBIR) imaging on a flash-heated Boeing 737 fuselage structure. We mapped surface temperature differences of 0.2 to 0.6 C for 5 to 14% thickness losses within corroded lap splices at 0.4 seconds after the heat flash. Our procedure mapped surface temperature differences at sites without surface-emissivity clutter (from dirt, dents, tape, markings, ink, sealants, uneven paint, paint stripper, exposed metal and roughness variations). We established the correlation of percent thickness loss with surface temperature rise using a partially corroded F-18 wing box and several aluminum panels which had thickness losses from milled flat-bottom holes. We mapped the lap splice composite thermal inertia, $(kpc)(sup (1/2))$, which characterized shallow skin defects within the lap splice at early times (less than 0.3 s) and deeper skin defects within the lap splice at late times (greater than 0.4 s). Corrosion invaded the inside of the Boeing 737 lap splice, beneath the galley and the latrine, where we observed 'pillowing' from volume build-up of corrosion by-products. DOE

N94-30787 Rensselaer Polytechnic Inst., Troy, NY.

NONLINEAR MULTIBODY FORMULATION FOR ROTORCRAFT ANALYSIS Ph.D. Thesis

NAM KOOK KANG 1993 281 p

Avail: Univ. Microfilms Order No. DA9325247

Rotorcraft systems include a wide range of different types of vehicles such as single, or tandem rotor helicopters and tilt rotors. Therefore a typical rotorcraft system can have several blades and rotors, fuselage and possibly wings. Similarly a variety of rotors such as articulated hingeless and bearingless rotor types have different physical characteristics, and rotor blades become complex with sweep, and twist, as well as composite materials. In view of these aspects, nonlinear multibody formulation for rotorcraft analysis has been developed. The formulation is based on the finite element method, allowing to model arbitrary complex multibody configurations. Two alternative multibody approaches are pursued and compared in terms of accuracy, computational efficiency and numerical stability and the final nonlinear multibody formulation is expressed in a single inertial system, using Cartesian coordinates to represent the configuration of each body. Elastic bodies are modeled as nonlinear beam elements which are naturally curved and twisted, and undergoing arbitrarily large deflections and rotations. Kinematic constraint elements allow an accurate modeling of multibody rotorcraft system and the constraint equations are enforced via an augmented Lagrangian formulation. After comparing various finite element and finite difference methodologies, a displacement based finite element method with Hilber-Huges-Taylor time integration scheme is used. This integration scheme introduces numerical dissipation into the time integration process to control high frequency numerical oscillations. This nonlinear multibody formulation is coupled with simplified aerodynamic model to treat realistic rotorcraft problems. Numerical results of nonlinear static problem of tension-bending-torsion coupled beam and rigid body dynamic problems show an excellent correlation with experimental data, or analytical results. Practical applications of this formulation are made for the airloads calculation in forward flight of the Sikorsky's H-34 and ground resonance prediction of the Boeing's 'Advanced Chinook' tandem helicopter. Dissert. Abstr.

N94-30905 FractuResearch, Inc., Galena, OH.

ANALYSIS CONCERNING THE INSPECTION THRESHOLD FOR MULTI-SITE DAMAGE Final Report, Apr. - Jun. 1991

D. BROEK Dec. 1993 51 p Limited Reproducibility: More than 20%

of this document may be affected by microfiche quality

(Contract DTR57-91-P-80859)

(PB94-142429; AD-A276593; DOT-VNTSC-FAA-93-7; DOT/FAA/CT-93/77) Avail: CASI HC A04

Periodic inspections, at a prescribed interval, for Multi-Site Damage (MSD) in longitudinal fuselage lap-joints start when the aircraft has accumulated a certain number of flights, the inspection threshold. The work reported here was an attempt to obtain justification for the threshold. It is based upon an analysis of fatigue data for lap-joints (riveted as well as riveted plus bonded) of a configuration closely resembling those in several types of aircraft. Depending upon the definition of threshold, the results show that it will be around 30,000 flights. Graphs are supplied upon the basis of which airworthiness authorities can determine a threshold in accordance with their preferred definition, and for different service conditions. NTIS

N94-30947# Aeronautical Research Inst. of Sweden, Stockholm.

FATIGUE MANAGEMENT AND VERIFICATION OF AIRFRAMES

A. F. BLOM and H. ANSELL Dec. 1993 30 p Presented at the 77th AGARD Structures and Materials Panel Meeting, Bordeaux, France, 27 Sep. - 1 Oct. 1993 Sponsored by Aeronautical Research Inst. of Sweden; Saab Military Aircraft; and Swedish Defence Material Administration

(FFA-TN-1993-55; ETN-94-95858) Avail: CASI HC A03/MF A01

The methodology currently used in Sweden for fatigue management and verification of airframes is described. Applications from the new fighter aircraft JAS39 Gripen are included in order to illustrate the various concepts being considered. Additional experience from recent work on the older fighter 37 Viggen is also included to highlight certain differences in the detail analyses, stemming from rather different nominal stress levels in the two aircraft. The following are discussed: the handling of load sequences and load spectra development, stress analyses and fracture mechanics analyses, fatigue crack growth modeling, component and full scale testing, service load monitoring regarding both the dedicated test aircraft, which is used to verify basic load assumptions, and also the individual load tracking program developed for the new fighter. ESA

N94-31078# Little (Arthur D.), Inc., Cambridge, MA.

A LABORATORY STUDY OF MULTIPLE SITE DAMAGE IN FUSELAGE LAP SPLICES Final Report, Nov. 1989 - Feb. 1992

R. MAYVILLE and M. SIGELMANN Dec. 1993 107 p Sponsored by FAA

(AD-A276151; DOT-VNTSC-FAA-93-12; DOT/FAA/CT-93/74) Avail: CASI HC A06/MF A02

This report details an experimental study that was conducted to explore the causes of fuselage lap splice multiple site damage (MSD), which has been observed in several aging aircraft. MSD was partially responsible for the 1988 Aloha Airlines accident. A specimen was designed and tests were conducted to investigate the effects on MSD and fatigue of: (1) a terminating action repair; (2) simultaneous tension and shear; and (3) stress and several lap splice configurations. The results of over 120 tests were supported by finite element analysis, strain gage studies and statistics. DTIC

N94-31387# Wright Lab., Wright-Patterson AFB, OH.

TESTING OPERATIONAL FLIGHT PROGRAMS (OFF'S) Final Report, 10 - 13 May 1993

CHARLES P. SATTERTHWAITHE Feb. 1994 13 p

(Contract AF PROJ. 9994)

(AD-A276361; WL-TR-94-1007) Avail: CASI HC A03/MF A01

Operational Flight Programs are the software programs of avionics embedded computer systems. Not only is it desirable to be able to test and model Operational Flight Programs, it is essential. The consequences of not performing accurate Operational Flight Program testing can be devastating. Some of these include premature weapon releases, erroneous flight instrument displays, and complete system failure. In order to test Operational Flight Pro-

grams, there are several things one must know about the Operational Flight Program, its weapon system host, its support environment, and how to generate and perform its test. This paper will address these issues as it develops a strategy to test an Operational Flight Program. DTIC

N94-31674# Technische Univ., Delft (Netherlands). Structures and Materials Lab.

DAMAGE TOLERANCE ASPECTS OF A FULL COMPOSITE AIRPLANE FUSELAGE: REQUIREMENTS, MODELLING, PREDICTIONS, EXPERIMENTS

M. N. VANBEIJNEN, M. J. L. VANTOOREN, T. DEJONG, and A. BEUKERS Jul. 1993 176 p
(LR-728; ETN-94-96138) Avail: CASI HC A09/MF A02

Composite fuselage structures are described, design concepts are mentioned, airworthiness rules for fuselage structures are discussed, and the loads on a fuselage structure and impact characteristics of composite materials are addressed. A theory for strength prediction, based on fracture mechanics and the stress intensity factor, under the presence of cracks is presented. Results of tests on stiffened panels are discussed. A stiffened panel which may improve the damage tolerance capabilities of the given composite sandwich fuselage structure is designed. A stiffened panel is produced and tested to check the predicted residual strength behavior of the panel. ESA

N94-31675# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

MULTIPLE-SITE DAMAGE IN AIRCRAFT FUSELAGE STRUCTURES

J. SCHIJVE Jul. 1993 29 p
(LR-729; ETN-94-96139) Avail: CASI HC A03/MF A01

Since the Aloha accident, the MSD (Multiple Site Damage) problem of riveted lap joints in aircraft fuselages has drawn much attention. The failure scenarios for a lead crack and more small MSD cracks as discussed by Broek and Swift are summarized, including results of relevant test series of Broek. Small MSD cracks are shown to possibly significantly reduce the load for unstable crack extension. Prevention of catastrophic consequences requires crack arresting capability of the structure. Related aspects of the problem setting are discussed with reference to failure criteria for ligament failure, the MSD problem for existing and new aircraft, and different options for crack stopper bands. Recommendations for future research are made. ESA

N94-31881 Virginia Polytechnic Inst. and State Univ., Blacksburg. **MULTIDISCIPLINARY OPTIMIZATION OF HIGH-SPEED CIVIL TRANSPORT CONFIGURATIONS USING VARIABLE-COMPLEXITY MODELING Ph.D. Thesis**

MATTHEW GERRY HUTCHISON 1993 157 p
Avail: Univ. Microfilms Order No. DA9318184

An approach to aerodynamic configuration optimization is presented for the high speed civil transport (HSCT). Methods to parameterize the wing shape, fuselage shape, and nacelle placement are described. Variable complexity design strategies are used to combine conceptual and preliminary level design approaches, both to preserve interdisciplinary design influences and to reduce computational expense. The preliminary design level analysis methods used to estimate aircraft performance are described. Conceptual design level (approximate) methods are used to estimate aircraft weight, supersonic wave drag and drag due to lift, and landing angle of attack. The methodology is applied to the minimization of the gross weight of an HSCT that flies at Mach 2.4 with a range of 5500 n.mi. Results are presented for wing planform shape optimization and for combined wing and fuselage optimization with nacelle placement. Case studies include both all-metal wings and advanced composite wings. The results indicate the beneficial effect of simultaneous design of an entire configuration over the optimization of the wing alone and illustrate the capability of the optimization procedure. Dissert. Abstr.

N94-31957 Utah Univ., Salt Lake City.

EFFECTS OF FREQUENCY AND AMPLITUDE VARIATIONS OF SUPERIMPOSED MINOR LOADING SEQUENCES ON THE CORROSION FATIGUE BEHAVIOR OF AIRCRAFT STRUCTURAL ALUMINUM ALLOYS Ph.D. Thesis

ANDREW DANTON PAULSON 1993 219 p
Avail: Univ. Microfilms Order No. DA9327339

Economic considerations have forced users of commercial jet transports to retain the services of aircraft that have surpassed the designed lifetime of structural components of the aircraft. With the increased service time that these aircraft are experiencing, many of the aircraft are becoming increasingly susceptible to corrosive attack. Additionally, the increased public awareness of commercial aircraft incidents has mandated that the behavior of so called 'aging' aircraft structures be better understood. Fatigue crack growth tests were conducted using four aluminum alloys that are commonly used in the structural components of commercial jet transports. Two of these materials represented materials that were commonly used in the construction of the what are now termed 'aging' aircraft. The other two materials are typically used in the new commercial transports. These materials were subjected to trapezoidal loading cycles with superimposed minor loading cycles. The amplitude and frequency of the minor loading cycles were varied in order to determine the effects of such loading variations on the corrosion fatigue behavior of the alloys. It was determined that the minor cycles did not influence the crack growth rate of the material below some specific minor cycle amplitude. Indications were seen that the amplitude at which the minor cycles become active may be influenced by the presence of the corrosive environment. The effect of the active minor cycles on the fatigue crack growth process could be seen in the crack growth rate curves and also in the fractographic analysis of the specimen surfaces. The combined influence of the frequency and environment on the fatigue behavior of the alloys was noted. Once the minor cycles had become active, a lower minor cycle frequency led to a larger impact of the corrosive environment. It is believed that the identification of the activity or inactivity of minor cycle loading will aid in the development of spectrum loading determined from actual components. The actual spectrums may be simplified based on the fact that specific minor cycles are known to be inactive, due to insufficient amplitude to effect the fatigue crack growth process. Dissert. Abstr.

N94-32015# Foster-Miller Associates, Inc., Waltham, MA.

FRACTURE AND FATIGUE STRENGTH EVALUATION OF MULTIPLE SITE DAMAGED AIRCRAFT FUSELAGES - CURVED PANEL TESTING AND ANALYSIS Final Report, Aug. 1989 - Mar. 1991

G. SAMAVEDAM and D. HOADLEY Jan. 1994 171 p
(Contract DTRS57-89-D-0009)
(AD-A277100; DOT-VNTSC-FAA-93-8; DOT/FAA/CT-94/10) Avail: CASI HC A08/MF A02

As the fleet of commercial passenger aircraft is utilized beyond their design lives, flaws have developed at the rivet holes of fuselage lap joints on some aircraft which can grow and link up into cracks of significant length. Understanding, predicting, and controlling this crack growth and the ensuing linkup requires analysis and evaluation of the structural parameters in concert with confirmation by testing representative models of the fuselage. A dedicated test facility has been designed, built, and tested for this purpose. Seven full-sized curved fuselage panels have been built and tested. This report describes the design rationale for the facility, the details of its construction and performance and the design and testing of compatible panels which simulate fuselage structural details. Data on basic material properties of interest to the aging aircraft issue have been compiled from existing Literature and from R-curve testing and rivet stiffness testing performed as part of the effort. Analytic techniques have been developed to evaluate stress distributions and to estimate elastic stress intensity factors for flat and curved test panels. A flat test panel has been designed that demonstrates hoop stress

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

equivalence to the curved fuselage. A 3-D FE mesh of a riveted lap joint is also presented. DTIC

N94-32058# Industrial Coll. of the Armed Forces, Washington, DC.

V-22: DUAL-USE TECHNOLOGY OR RED HERRING? Research Report, Aug. 1993

WILLIAM H. ROUND Apr. 1993 43 p

(AD-A276577; NDU-ICAF-93-F39) Avail: CASI HC A03/MF A01

The V-22 Osprey has been a pawn in the battle between requirements and costs almost from its inception. The major factors with regard to the future of the V-22 are a combination of economic, political and military considerations. It is well known that a coalition of industry, congress and covertly the Marine Corps are on one side of the argument facing the administration and the Office of the Secretary of Defense (OSD) on the other. Each side has invoked arguments either for or against the program in the areas of economics (cost) and utilization (need) requirements. DTIC

N94-32062 Aeronautical Systems Div., Wright-Patterson AFB, OH. **AIRCRAFT WEIGHT PREDICTION CAPABILITY. VOLUME 1: WEIGHT STUDY AND RESULTS Final Report, 1 Jan. - 30 May 1993**

THOMAS E. OOLE May 1993 65 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-A277206; ASC-TR-93-5022-VOL-1) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

This report presents the study results, conclusions and recommendation of the application of various weight prediction methodologies to three modern aircraft that are representative of low observable (LO) and/or advanced technologies. In the continuous effort of the Mass Properties Group of the Flight Systems Engineering Division to improve the correlation of predicted weight to actual weight, this report and the corresponding study are intended to serve as a guide to the strength and weaknesses of current available prediction methodologies, identification of technical areas for which methodology is either lacking or inadequate, and recommendations to enhance our capability. Volume 1 of this report documents the background of the study, the weight estimation process of this office, the approach to the study, general results, conclusions, and recommendations to correct deficiencies and improve the Air Force capability. The following volumes will document the methodologies used and the detailed results for the aircraft analyzed. DTIC

N94-32264 Aeronautical Research Labs., Melbourne (Australia). **FINITE ELEMENT ANALYSIS OF MB326H MACCHI WING LOWER SPAR CAP FATIGUE CRACKS**

D. REES Dec. 1993 30 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-A277062; ARL-TN-63; DODA-AR-008-410) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

A three dimensional finite element analysis of cracks in the MB326H Macchi wing lower spar cap is presented. The case of cracks emanating from the intersection of a wing attachment fitting bolt hole and a web attachment fastener hole at wing station Y900 is considered. Stress intensity factors for two proposed crack geometries and the residual strength of the ligament above the web attachment fastener hole in the spar cap flange are calculated. DTIC

N94-32378 Materials Research Labs., Ascot Vale (Australia). **IMPROVED RESEALING PROCEDURES FOR THE SECOND DESEAL/RESEAL PROGRAM IN RAAF F111 AIRCRAFT FUEL TANKS**

S. BATTEN, R. H. HUANG, and L. V. WAKE Jan. 1994 33 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-A277069; MRL-TR-93-64; DODA-AR-008-616) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

A high temperature-resistant polyester sealant was originally employed to seal faying surface grooves in F-111 fuselage fuel tanks as well as structural voids and aerodynamic surfaces. Chemical hydrolysis of this material was detected in March 1974 and led to its replacement by a polysulfide sealant in the late 70's and early 80's. Where possible, the polyester was removed, however much of it remained inaccessibly located between the overlapping panels. It was found that the continued hydrolysis of this residual polyester generated sufficient pressure to penetrate the polysulfide sealant resulting in fuel leaks as well as appearing externally in trails along the skin of the aircraft. To protect the polysulfide from penetration, a mechanical barrier was applied in the form of a layer of epoxy polyamide between the polysulfide and the polyester. This system was successful for some years, however the occurrence of fuel leaks had become unacceptable by 1987. All F-111 aircraft suffered numerous fuel leaks over the period 1988-91 including a number of safety-of-flight (SOF) incidents. A detailed investigation was therefore requested to identify the cause(s) of sealant failures. This investigation found that the sealant and the underlying epoxy barrier coating could be manually peeled from the painted tank surface when prepared by the recommended methods and that two procedures were responsible for the poor adhesion. One of the procedures involved application of the barrier coating over incomplete cure priming paint resulting in solvent attack of the barrier. The second procedure, involving the use of a so-called titanate adhesion promoter, significantly reduced peel strength of the barrier coating to the paint. DTIC

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

N94-31368# Wright Lab., Wright-Patterson AFB, OH. **TECHNOLOGIES FOR AVIONICS EMBEDDED COMPUTER SYSTEMS Final Report, period ending 17 Feb. 1993**

CHARLES P. SATTERTHWAITHE Feb. 1994 15 p

(Contract AF PROJ. 9994)

(AD-A276364; WL-TR-94-1010) Avail: CASI HC A03/MF A01

Avionics embedded computer systems are an important part of the United States Air Force's plans for using advanced technologies to keep their aircraft highly capable and superior. Highly desirable features such as reconfigurability, rapid turnaround, expandability, and testability are made increasingly available through the use of these embedded systems. This paper discusses avionics embedded computer systems primarily through a discussion of their Operational Flight Programs (OFP's), near and far term requirements of OFP maintainers, and current technologies being developed for OFP maintenance. DTIC

N94-31458# Wright Lab., Wright-Patterson AFB, OH. **ANALYSIS OF THE EFFECT OF ROUTING STRATEGIES FOR PARALLEL IMPLEMENTATIONS OF A SELECTED AVIONICS APPLICATION Interim Report, 1 Feb. 1992 - 1 Sep. 1993**

JASON L. CARTER and STEPHEN L. HARY Dec. 1993 72 p

(Contract AF PROJ. 2003)

(AD-A276069; WL-TR-93-1173) Avail: CASI HC A04/MF A01

The purpose of this study is to evaluate the Texas Instruments TMS320C40 (C40) digital signal processor for a selected avionics application. In this effort, the C40's on-chip communication ports are benchmarked to give indications of the amount of overhead involved in initiating a message transfer and the data throughput rates of the network. A network of C40's is compared to an iWarp parallel processor to compare the processing capabilities between the C40's store-and-forward router and the iWarp's wormhole router. Several network topologies that can easily be constructed from C40's are described, along with ways of partitioning an image processing task across each of them. Performance measurements of both the C40's

and iWarp's performance on parallelized implementations of the image processing algorithm are detailed, along with estimated measurements for large-scale arrays of C40's. Finally, the C40's computing power is compared with an avionics hardware program being developed at Wright Laboratories, System Avionics Division, Information Processing Technology Branch. DTIC

N94-31903 Canadian Marconi Co. Ltd., Kanata (Ontario).
STUDY OF VIRTUAL PROTOTYPING OF AIRCRAFT INSTRUMENTS Concluding Report
PETER M. WELLS, R. D. KOBIERSKI, and GORDON YOUNGSON
9 Aug. 1993 204 p
(CMC-0687-1090; DSIS-94-01381; CTN-94-61215) Copyright Avail: CASI HC A10/MF A03

A project was initiated to identify the methodology, cost parameters, and data structure required to create a taxonomy of Canadian Forces aircraft cockpit representations using the Virtual Applications Prototyping System (VAPS). The cockpit panels of the CC-130H Hercules were selected for prototyping as they provide a convenient and timely test case for this process. During the data collection process required to support generation of the VAPS prototypes, a number of lessons were learned regarding both aircraft cockpit preparation and photographic techniques. A VAPS prototype library has been designed which utilizes the capacity of VAPS to create composite prototypes by loading reference components from other files. This effort resulted in generation of significantly more complex VAPS prototypes than those previously used. The variety of options used to improve performance, including hardware and software based approaches, are discussed. A VAPS component inventory database was created for systematic organization of information on components of VAPS prototypes. Efforts were made to establish links between the VAPS and other applications, and to develop software tools to enable the VAPS prototype library to support systems engineering tasks. A low-cost cockpit demonstration system that would maximize the utility of VAPS prototypes is also proposed. Author (CISTI)

N94-32223# Logicon Technical Services, Inc., Dayton, OH.
ASSESSMENT OF INTERIOR MODIFICATIONS IN C-130 AND C-141 AIRCRAFT FOR NIGHT VISION GOGGLE OPERATIONS Final Report, Mar. - Dec. 1992
JEFFREY L. CRAIG May 1993 20 p
(Contract F33615-89-C-0532)

(AD-A276843; AL/CF-TR-1993-0095) Avail: CASI HC A03/MF A01
An evaluation was conducted to examine the effects of interior paint scheme modifications to C-130 and C-141 aircraft on night vision goggle (NVG) operations. The evaluation consisted of direct measurement of aircraft interior radiance levels, calculation of surface reflectivities, and a human factors assessment of effects on aircrew NVG performance. The data were collected for both modified and original interior scheme C-130 and C-141 aircraft at Pope AFB and Charleston AFB, respectively. Reflectance values were determined for various flight deck and cargo bay surfaces. The reflectance values were calculated from the radiance levels within the sensitivity range of the NVG's. The results indicated that the reflectances were higher in modified aircraft for the majority of surfaces measured, but well within the specifications set by the relevant military standard. The human factors evaluation indicated that the vast majority of aircrew responding experienced no adverse effect on NVG performance attributable to the new interior scheme. In general, it was concluded that the modified interior scheme should not interfere with NVG operations. DTIC

N94-32328 Air Force Occupational Measurement Center, Randolph AFB, TX.
AIRCRAFT COMMUNICATION AND NAVIGATION SYSTEMS AND COMMUNICATION AND NAVIGATION SYSTEMS Occupational Survey Report
Jan. 1994 151 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A277309; AFPT-90-455-876) Avail: CASI HC A08

This report presents the results of a detailed Air Force (AF) occupational survey of the communication and navigation systems career ladder Air Force Specialty Codes (AFSCs) 2A4X2 and 2A1X3 (formerly 453X2 and 455X2, respectively). Authority for conducting occupational surveys is contained in AFR 35-2. DTIC

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

N94-30914 National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
FRACTOGRAPHIC AND MICROSTRUCTURAL ANALYSIS OF FATIGUE CRACK GROWTH IN Ti-6Al-4V FAN DISC FORGINGS R. J. H. WANHILL and C. E. W. LOOIJIE 30 Sep. 1991 46 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-B174765; NLR-TP-91142-U; ETN-94-95565) Avail: CASI HC A03

The constant amplitude and flight simulation (TURBISTAN) fatigue crack growth behavior of Ti-6Al-4V fan disc forgings, tested in an engine disc cooperative test program, was investigated by fractographic and microstructural analysis. The crack growth curve shapes and fractographic characteristics were similar. Transitions in the fatigue crack growth curves correlated with a change from structure sensitive to continuum mode crack growth, primarily in the transformed and aged beta grains, and decreased fracture surface roughness. The transitions were most probably caused by the maximum plane strain cyclic plastic zone sizes becoming equal to and exceeding the average platelet alpha packet sizes. The significance of such transitions for prediction of fatigue crack growth and service failure analysis is discussed. ESA

N94-30935 Ohio State Univ., Columbus.
POTENTIAL OF THE RAMJET ENGINE FOR HYPERSONIC FLIGHT SPEEDS Ph.D. Thesis
SAMI JAMIL ANTOUN 1993 203 p
Avail: Univ. Microfilms Order No. DA9325456

Although the concept of the supersonic combustion ramjet (scramjet) is not new, the maximum flight speed that can be achieved by this power plant has not been established to date. The purpose of this dissertation is to determine the maximum flight speed at which the scramjet is capable to produce enough thrust to overcome its own external drag. In order to determine the maximum flight speed, the net thrust developed by the scramjet is compared to the external drag acting on it for flight Mach numbers 7 to 25. Using an ideal engine cycle, it will be shown that the maximum flight Mach number of the scramjet is approximately 23. When more realistic assumptions are used to include the effects of stagnation pressure loss due to viscous effects and combined friction at the wall of the combustion chamber, the maximum flight Mach number which the scramjet engine may produce is about 12. In this analysis, the flow at the end of each of the engine components is assumed to be one dimensional and in chemical and thermodynamic equilibrium. Performance losses due to incomplete mixing and combustion of fuel and air have not been considered. Dissert. Abstr.

N94-31290# Naval Postgraduate School, Monterey, CA.
AN ANALYSIS OF NON-INTEGERIZING THE AIRCRAFT ENGINES COST EFFECTIVENESS ANALYSIS SPREADSHEET MODEL (CEAMOD VERSION 2.0) M.S. Thesis
KARL F. RAU Dec. 1993 114 p
(AD-A276251) Avail: CASI HC A06/MF A02

This thesis investigated the effect of integerization in the Cost Effectiveness Analysis Spreadsheet Model (CEAMOD Version 2.0) used by the Navy and the Air Force for decision-making in their

aircraft engine Component Improvement Programs (CIP). A non-integrated model was developed and sensitivity analysis was performed to determine the cost drivers of the revised model. Three major cost drivers were then utilized as sensitivity analysis tools for comparing the decision values obtained from the current model with those obtained from the revised model. The author concluded that while the non-integrated CEAMOD is more theoretically correct, it would not lead to different decisions than CEAMOD Version 2.0.

DTIC

N94-31931 Pennsylvania State Univ., University Park. Applied Research Lab.

SOLUTION OF THE AVERAGE-PASSAGE EQUATIONS FOR THE INCOMPRESSIBLE FLOW THROUGH MULTIPLE-BLAD-ROW TURBOMACHINERY

J. J. DREYER and W. C. ZIERKE Feb. 1994 125 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(Contract N00039-92-C-0100)

(AD-A276515; PSU/ARL-TR-94-05) Avail: CASI HC A06

A system of equations governing the incompressible flow through a multiple-blade-row turbomachine is presented. These equations basically form the pseudo-compressible analog to the equations derived by Admachy 1984 for compressible, average-passage flow. The methodology behind the derivation is outlined, including a closure model for the time-averaged form of the equations. The equations are then preconditioned to facilitate numerical treatment. An explicit numerical procedure based on Runge-Kutta time stepping for cell-centered, hexahedral finite volumes is outlined for the approximate solution of the governing equations. Convergence acceleration techniques, boundary conditions, and closure issues are also addressed for the numerical scheme. Finally, results are presented for a simulation of the high Reynolds number flow through a two-blade-row, axial-flow pump. These comparisons suggest that the pseudo-compressible average-passage equations can make reasonable predictions.

DTIC

N94-31967 Stevens Inst. of Tech., Hoboken, NJ.
COMPUTATIONAL PREDICTION OF STALL FLUTTER IN SPANWISE-FINITE BLADE CASCADES Ph.D. Thesis
TSONG-HSIN CHEN 1993 160 p

Avail: Univ. Microfilms Order No. DA9328508

Aeroelastic instabilities in turbomachinery are of great importance in practice and in the design process. Stall flutter is one of the important off-design phenomena at which airfoils experience flow separation with propagating stall cells. Prediction to prevent the onset of stall for given blade geometry and material properties is necessary. In this study, the unsteady aeroelastic behavior of the turbomachinery blade cascades is analyzed. A 'pseudo-three-dimensional' approach based on the well-tested vortex method is employed for the unsteady aerodynamics of spanwise-finite turbomachine blade cascades. The cascaded airfoils are modeled structurally using discretized beam theory and coupled with the unsteady aerodynamics algorithm for simultaneous solution by a time-marching technique. Before performing these computations, the static blade deflections and natural frequencies with/without rotation are all compared with the available experimental and analytical works to ensure the reliability of the structure dynamics algorithm. A six-element blade is proposed in order to reduce the CPU time and yet maintain acceptable accuracy. The mutual interaction of the structural dynamic displacement and the unsteady aerodynamic loading is effectively captured by this algorithm. The pseudo-three-dimensional results for the spanwise-finite airfoil cascades are shown to compare well with those for infinite linear cascades modeled by a two-dimensional characteristic section with a single degree-of-freedom in either bending or torsion. The computational results for a cascade of compressor blades with pretwist show that the bending motion normal to the chord dominates blade displacement for stall flutter in the fundamental frequency mode. The results also indicate that while entrainment or frequency syn-

chronization may occur over a certain interval of frequency, the spanwise behavior of the cascade can exhibit considerable variations. The possibility of the second harmonic of the stall frequency exciting the blade at its natural frequency is uncovered. As to a lower stiffness blade, the torsional motion is found to dominate the whole motion and evoke a similar entrainment response like pure torsional motions in two-dimensional cascades. Finally, the chaotic behavior of nonlinear systems is observed in the aerodynamics of airfoil cascades when a coherent vibration is not present in coupled mode flutter. However, the limit cycle behavior is shown to be present in pure torsional or bending mode flutter.

Dissert. Abstr.

N94-32026 Naval Postgraduate School, Monterey, CA.
DEVELOPMENT OF A CASCADE SIMULATION OF FAN-PASSAGE FLOW M.S. Thesis

ERICA TAPP Dec. 1993 139 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(AD-A277234) Avail: CASI HC A07

A small-scale blowdown wind tunnel apparatus was developed to investigate techniques to alleviate the negative effects of shock-boundary layer interaction in the blading of aircraft engine fans. Using shadowgraph and surface injection techniques, probe surveys, and static pressure measurements, it was shown that acceptable periodicity and repeatability could be obtained in a two-passage cascade model at $M = 1.4$ if air supply pressure, back pressure, and porous-wall bleed pressures were properly controlled. It was also shown that local separation due to shock boundary layer interaction was present at the design flow incidence of 1.15° , but not at 0.85° . Complete data are reported for the design condition to serve as a baseline for separation alleviation experiments. Necessary hardware and software developments are also documented.

DTIC

N94-32075* Case Western Reserve Univ., Cleveland, OH.
ANTIWIINDUP ANALYSIS AND DESIGN APPROACHES FOR MIMO SYSTEMS Final Report

VINCENT R. MARCOPOLI and STEPHEN M. PHILLIPS Apr. 1994 8 p See also A93-51403

(Contract NAG3-1232; RTOP 505-62-50)

(NASA-CR-195304; E-8706; NAS 1.26:195304) Avail: CASI HC A02/MF A01

Performance degradation of multiple-input multiple-output (MIMO) control systems having limited actuators is often handled by augmenting the controller with an antiwindup mechanism, which attempts to maintain system performance when limits are encountered. The goals of this paper are: (1) To develop a method to analyze antiwindup systems to determine precisely what stability and performance degradation is incurred under limited conditions. It is shown that by reformulating limited actuator commands as resulting from multiplicative perturbations to the corresponding controller requests, mu-analysis tools can be utilized to obtain quantitative measures of stability and performance degradation. (2) To propose a linear, time invariant (LTI) criterion on which to base the antiwindup design. These analysis and design methods are illustrated through the evaluation of two competing antiwindup schemes augmenting the controller of a Short Take-Off and Vertical Landing (STOVL) aircraft in transition flight.

Author

N94-32238 Naval Postgraduate School, Monterey, CA.
ANALYSIS OF NAVY AIRCRAFT ENGINE AND ENGINE COMPONENT WARRANTIES M.S. Thesis

MELISSA S. ANDREWS and SUZANNE C. HICKEY Dec. 1993 136 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(AD-A276936) Avail: CASI HC A07

Since the enactment of Title 10, Section 2403 of the United States Code in 1985, written warranty clauses have been mandated for the procurement of all major weapon systems. This thesis discusses the aircraft engine warranty program established by the Naval Air Systems Command in response to that warranty legislation. Warranty procedures and issues are examined during procure-

ment, contract negotiations, and in the daily operations of the fleet. The aircraft engine warranty program of a major commercial airline (United Airlines) is presented to allow the reader to form a basis from which to make program comparisons. Those areas in which a commercial warranty may be applicable to a military environment are described and analyzed. Conclusions are drawn concerning the effectiveness of the Navy's warranty program and recommendations are suggested for improvements and/or follow on studies.

DTIC

08

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N94-31203* California Polytechnic State Univ., San Luis Obispo. **CONTROLS DESIGN WITH CROSSFEEDS FOR HOVERING ROTORCRAFT USING QUANTITATIVE FEEDBACK THEORY** Semiannual Progress Report, Nov. 1993 - Mar. 1994

DANIEL J. BIEZAD 15 Apr. 1994 30 p

(Contract NCC2-833)

(NASA-CR-195765; NAS 1.26:195765) Avail: CASI HC A03/MF A01

This work is extending the research accomplished on project NCC2-751. A newly implemented helicopter model has been used to simulate 25 flight configurations near hover for the UH-60 RASCAL aircraft. A new engine model has been installed in the FORECAST simulation (alias UMGENHEL) for the better prediction of the yaw and heave responses. By applying the decoupling metric from project NCC 751 it was determined that the aileron to pitch and the elevator to yaw responses do not indicate the need for crossfeeds since both of them have a decoupling metric value over 20 dB (less than 10 percent coupling). In the case of the aileron to heave and the elevator to heave responses, the large size and the overlapping of the templates indicate that a low-order dynamic crossfeed cannot be found. The low-order dynamic crossfeed selection is proceeding, however, for the remaining eight crossfeeds. Note that most of them have successfully decoupled the system by 20 dB or more, except for the rudder to heave crossfeed (18.2 dB). It is probable that the engine model needs more accuracy to further improve the heave to yaw crossfeed decoupling metric value. To see how the new low-order dynamic crossfeeds perform, a simulation was accomplished using MATLAB SIMULINK. Author (revised)

N94-31677* Ecole Centrale de Lyon (France). Lab. de Mecanique des Solides.

AEROELASTIC VIBRATIONS OF LIFTING SURFACES Ph.D. Thesis [VIBRATIONS AEROELASTIQUES DES SURFACES PORTANTES]

COSMAS PANDITPAGWIWOKO 1991 159 p In FRENCH (ECL-91-01; ETN-94-95985) Avail: CASI HC A08/MF A02

Work to establish calculation methods for solving aeroelastic problems is presented. The software developed is listed, and calculations were carried out for a hypothetical missile. A calculation method for unsteady aerodynamic loads in the subsonic and supersonic regimes modeling the lifting surface by singularities is presented. The problem of aeroservoelasticity is addressed. Flutter forces are presented in the form of a V-g diagram and by the place of the dynamic system transfer function roots. Aeroelastic responses of the nonlinear system and the control system are observed in the time domain. During numerical simulation, the gust effect and noise in the aeroelastic behavior are taken into account.

ESA

N94-31837* Toronto Univ. (Ontario). Flight Simulator Lab. **DEVELOPMENT OF A RECONFIGURABLE HELICOPTER FLIGHT CONTROL SYSTEM M.S. Thesis**

PAVAN RAJAGOPAL 1992 342 p

(ISBN-0-315-87218-7; CTN-94-61256) Copyright Avail: Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

A helicopter response type is a description of the coupling between the cockpit controls and the flight characteristics of the helicopter. A helicopter can be used to perform several different tasks, each requiring a different response type. During a given mission, it may be necessary to execute several tasks and therefore there is a requirement to be able to change the control configuration, or to reconfigure the control, while in flight. A study was conducted to examine the possibility of switching between configurations during flight and to determine the best way to achieve a control transition. An automatic control system was implemented on a helicopter simulator and a set of control algorithms was obtained which implemented seven response types. Most of these algorithms used proportional feedback. Two attempts were made to develop a control reconfiguration strategy. It was found that the most critical factor is the minimization of a control discontinuity over a transition. A method was developed to achieve such a minimization by setting the reference or initial control deflection equal to the current or final control deflection of the old configuration. The tests performed on the reconfiguration algorithms show that smooth transitions are achievable between all response types in the appropriate channels.

CISTI

N94-32217* Army Aeromedical Research Lab., Fort Rucker, AL. **TECHNICAL EVALUATION OF THE UH-60Q: AIRCRAFT IN TYPICAL AEROMEDICAL EVACUATION MISSIONS**

JAMES E. BRUCKART and JOSEPH R. LICINA Feb. 1994 37 p (AD-A276944; USAARL-94-10) Avail: CASI HC A03/MF A01

The UH-60Q prototype MEDEVAC Black Hawk is configured to provide day/night, adverse weather, emergency movement of patients. The objective of this report is to describe the ability of the prototype aircraft to perform typical aeromedical evacuation missions. The prototype aircraft performed five simulated day and night medical evacuation missions as described in the Materiel Need Statement for the Dustoff UH-60Q. Medical aidmen and aviators rated the medical interior and avionics systems and provided comments on their in-flight experiences. The prototype UH-60Q Black Hawk is capable of performing the typical MEDEVAC missions. Nondevelopmental components of the medical interior require some refinements including improved vertical clearance for litters, improved durability, and environmental tolerance. Communications and cabin lighting require additional study to refine these requirements.

DTIC

N94-32224* RANN, Inc., Palo Alto, CA.

ACTIVE CONTROL FOR FIN BUFFET ALLEVIATION Final Report, Jun. 1992 - Jun. 1993

HOLT ASHLEY, STEPHEN M. ROCK, RAMARAO DIGUMARTHI, KENNETH CHANEY, and ALFRED J. EGGERS, JR. Jan. 1994 142 p

(Contract F33615-92-C-3605)

(AD-A276844; WL-TR-93-3099) Avail: CASI HC A07/MF A02

A one year program of research for fighter aircraft with twin vertical stabilizers and which operate at high angles of attack was undertaken the following objective: to examine the possibility that active control can alleviate the response to buffeting and enhance fatigue life of the structure. Although there is no way that the phenomenon could have been anticipated during the initial phases of their design, 'fin buffeting' as a consequence of high-alpha maneuvers has been encountered on several military aircraft with such twin tails. Other affected fighters include the F-14 and the F/A-18. Future designs for which some level of buffeting is anticipated are the F-22. Measurements on a wind-tunnel model have already reported fin buffeting. Although they have single, center-line, vertical stabilizers, similar phenomena have occurred at high alpha on the X-29 and the X-31.

DTIC

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

N94-30788 George Washington Univ., Washington, DC.
ANALYSIS OF FLUCTUATING STATIC PRESSURE MEASUREMENTS IN A LARGE HIGH REYNOLDS NUMBER TRANSONIC CRYOGENIC WIND TUNNEL Ph.D. Thesis
 WILLIAM B. IGOE 1993 258 p
 Avail: Univ. Microfilms Order No. DA9329869

Dynamic measurements of fluctuating static pressure levels were made using flush mounted high frequency response pressure transducers at eleven locations in the circuit of the National Transonic Facility (NTF) over the complete operating range of this wind tunnel. Measurements were made at test section Mach numbers from 0.2 to 1.2, at pressure from 1 to 8.6 atmospheres and at temperatures from ambient to -250 F, resulting in dynamic flow disturbance measurements at the highest Reynolds numbers available in a transonic ground test facility. Tests were also made independently at variable Mach number, variable Reynolds number and variable drivepower, each time keeping the other two variables constant thus allowing for the first time, a distinct separation of these three important variables. This report contains a description of the NTF emphasizing its flow quality features, details on the calibration of the instrumentation, results of measurements with the test section slots covered, downstream choke, effects of liquid nitrogen injection and gaseous nitrogen venting, comparisons between air and nitrogen, isolation of the effects of Mach number, Reynolds number and fan drive power, and identification of the sources of significant flow disturbances. The results indicate that primary sources of flow disturbance in the NTF may be edge-tones generated by test section sidewall reentry flaps and the venting of nitrogen gas from the return leg of the tunnel circuit between turns 3 and 4 in the cryogenic mode of operation. The tests to isolate the effects of Mach number, Reynolds number and drive power indicate that Mach number effects predominate. A comparison with other transonic wind tunnels shows that the NTF has low levels of test section fluctuating static pressure especially in the high subsonic Mach number range from 0.7 to 0.9. Dissert. Abstr.

N94-30856 National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
'REAL TIME' AND THE NLR AERODYNAMIC FACILITIES
 R. K. VANDERDRAAI 23 Mar. 1992 16 p Presented at the NLUUG Conference, Ede, Netherlands, 6 May 1992 Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
 (AD-B173626; NLR-94-92113-U; ETN-94-95573) Avail: CASI HC A03

Reasons for the real time characteristics of the computer systems directly connected to a wind tunnel, and which are used for data acquisition, process control and data processing, are given. The choice of a computer to perform any of these tasks is described, and strategies to do so are given. An example of choosing a real time control system for use in aerodynamic facilities is outlined. The choice of the computer was made in the HP computer domain. Therefore, the choice between UNIX or a real time environment was needed. It turned out that the UNIX (HP-UX) computers (HP9000) do not respond as fast as RTE-A computers, while the RTE-A computers (HP1000) are not as fast as the HP9000 computers. After precise definition of the problem and careful analysis of the computer properties for this particular problem, HP1000 RTE-A machines were chosen. ESA

N94-31058# Dayton Univ. Research Inst., OH.
VARIABLE-RESOLUTION IMAGERY FOR FLIGHT SIMULATION Final Report, Jun. 1989 - Jun. 1993

GEORGE A. GERI, YEHOSHUA Y. ZEEVI, and CRAIG A. VRANA
 Jan. 1994 100 p
 (Contract F33615-90-C-0005)

(AD-A276199; AL/HR-TR-1993-0180) Avail: CASI HC A05/MF A02

A position-varying, low-pass filter was used to produce variable-resolution images whose spatial frequency content varies as a function of distance from their center. Such images can be matched in some sense to the spatial inhomogeneities of the human visual system, and thus, they may be visually acceptable even though they contain less information than an unprocessed version of the same image. Following a discussion of image representation with nonuniform sampling and of the concept of locally bandlimited spaces, two experiments were performed to visually assess variable-resolution images. In Experiment 1, images were generated using a series of distortion functions (differing in central blur, peripheral blur, and blur gradient) chosen to approximate cortical magnification functions (CMFN's) derived from existing anatomical and psychophysical data. The distortion functions, corresponding to the images that were just discriminable from an unprocessed image, were used to define the wide-field CMFN associated with changes in blur discrimination across the visual field. In Experiment 2, blur thresholds were measured using apertures in the form of either circles or 3 deg-wide angular segments centered in either 15 deg or 30 deg eccentricity. Differences in blur discrimination for the two stimulus configurations, matched in area, suggest that the spatial organization of the visual mechanisms underlying blur discrimination changes with eccentricity. Finally, the perceptual data obtained here were used to efficiently sample and represent a variable-resolution image. DTIC

N94-31179# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

AIRCRAFT SIMULATION AND PILOT PROFICIENCY: FROM SURROGATE FLYING TOWARDS EFFECTIVE TRAINING

P. G. A. M. JORNA, E. R. A. VANKLEEF, and W. P. BOER 30 Jul. 1992 32 p Presented at the AGARD Conference on Piloted Simulation Effectiveness, Brussels, Belgium, 1992
 (AD-B179300; NLR-TP-91489-U; ETN-94-95973) Avail: CASI HC A03/MF A01

Experiences with the application of simulators in military flight training are reviewed and research strategies like the development of objective performance measures in support of validation trials and future simulator development are reported. It is proposed to prototype simulator concepts before implementing them and relevant research initiatives in this area are reviewed. The credibility of simulators is assessed from a pilot's perspective. It is noted that a missing link between simulator and real flight is the obvious absence of physical danger. Safety serves to reduce anxiety and influences the pilot strategies for task execution: who is afraid of crashing a simulator. Effects of anxiety on performance could be demonstrated and interactions with high workload conditions occurred. Coping with the mental perils of flight is an important component of pilot proficiency and simulating such an environment, or at least its impact on performance, is one of the many challenges for the training community. ESA

N94-31295# TeSCO, Inc., Tullahoma, TN.
MODEL BORNE DATA MANAGEMENT SYSTEM FOR WIND TUNNEL TESTING, PHASE 2 Final Report, 1 Oct. 1991 - 1 Oct. 1993

LEE F. WEBSTER and T. S. PAIGE Nov. 1993 37 p
 (Contract F33615-91-C-3007)
 (AD-A276296; TESCO-TR-93-1-PHASE-2; WL-TR-93-3125-PHASE-2) Avail: CASI HC A03/MF A01

This report covers the development of a modern model mounted wind tunnel data acquisition and processing system called MDARS, short for Modular Data Acquisition and Recording System. During this Phase, prototypes of the model borne components and the pc interface were developed. The system was then installed in a HP-MaRV model for demonstration testing in AEDC's wind tunnel B. Following these tests the performance and durability of the system

was analyzed and lessons learned were identified and incorporated into a production version of the system. These activities resulted in a proven data system, ready for marketing. The MDARS uses modern high density surface mount components in a compact modular/bus arrangement which allows a size which can be accommodated by most wind tunnel models. It also allows the system to be controlled and data to be acquired by a modern personal computer thus decreasing or eliminating dependence on facility data systems. The system multiplexes all data channels and converts all analog signals digital. The remote system communicates with the Control Personal Computer by fiber optic cable. The use of MDARS will reduce facility data system dependence while reducing test set up costs and schedule delays. DTIC

N94-31318 Naval Surface Weapons Center, Silver Spring, MD.
HYPERVELOCITY TUNNEL 9 MACH 10/14 CALIBRATION
DAN MARREN 31 Jan. 1994 65 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-A275960; NSWCDD/TR-92/160) Avail: CASI HC A04

This report documents the Tunnel 9 Mach 10/14 Calibration test program (WTR 1608) performed at the Naval Surface Warfare Center, White Oak, Maryland. This effort was sponsored by the National Aerospace Plane Joint Program Office (NASP JPO). Free stream flow field parameter distributions were obtained for both the Mach 10 and 14 nozzles spanning the Reynolds number range. A total of four Mach 10, and ten Mach 14 runs were performed during this test program. The test period was 7 to 22 May 1991. Results from this test entry were combined with previous test data in the final analysis. Data from the test reveal that high quality uniform flow exists and that deviations in core flow field parameters are comparable with the calibration data taken in the past. DTIC

N94-31346# IBM Federal Systems Div., Gaithersburg, MD.
CLEANROOM ENGINEERING HANDBOOK. VOLUME 6: CERTIFICATION TEAM PRACTICES
31 Jul. 1993 54 p
(Contract F19628-88-D-0032)
(AD-A275951) Avail: CASI HC A04/MF A01

This is one of a series of six engineering handbooks prepared for and used by the engineering staff at Picatinny Arsenal for the STARS technology transfer demonstration. The handbooks define the engineering process and algorithms that will be used in Cleanroom projects. They are designed to provide support to trained engineers using Cleanroom engineering, not to substitute for training. This volume describes the activities of Cleanroom software certification for each increment/accumulation of project development. Process P5.j.2, preparation for certification of accumulation j, and process P6.j, software certification for accumulation j, are expanded into engineering subprocesses (i.e., tasks) for execution by Cleanroom-trained software engineers. These tasks result in the preparation for and performance of the certification of developed software. DTIC

N94-31356# IBM Federal Systems Div., Gaithersburg, MD.
CLEANROOM ENGINEERING HANDBOOK. VOLUME 1: CLEANROOM ENGINEERING PROCESS INTRODUCTION AND OVERVIEW
31 Jul. 1993 46 p
(Contract F19628-88-D-0032)
(AD-A275949) Avail: CASI HC A03/MF A01

This is one of a series of six engineering handbooks prepared for and used by the engineering staff at Picatinny Arsenal for the STARS technology transfer demonstration. The handbooks define the engineering process and algorithms that will be used in Cleanroom projects. They are designed to provide support to trained engineers using Cleanroom Engineering, not to substitute for training. This handbook, Volume 1, presents an introduction to the Cleanroom engineering process model and is recommended for all software planning and development participants. It defines the Cleanroom process in light of the project organization which consists of: The Specification Team; The Development Team; The Certification

Team; and the software transformations which are: Specification Development - To define the software system to be developed and record the definition in the specification document; and Software Development and Certification - To develop and certify software in the target language that runs on the target processor and exhibits the same behavior described in the specification. DTIC

N94-31710# Royal Military Coll. of Canada, Kingston (Ontario). Dept. of Civil Engineering.
DETERMINING THE BEARING CAPACITY OF FLEXIBLE AIRFIELD PAVEMENTS USING A HEAVY WEIGHT DEFLECTOMETER M.S. Thesis
R. E. FENTON Sep. 1992 173 p
(ISBN-0-315-86210-6; CTN-94-61186) Copyright Avail: Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

In 1985, increasing costs and the inconvenience associated with conducting plate bearing tests prompted Transport Canada to investigate the feasibility of replacing the controlled rate of loading (CROL) test with falling weight deflectometer testing for determining the standard surface bearing strength Pstd of flexible airfield pavements. In summer 1990, 180 heavy weight deflectometer (HWD) and CROL tests were conducted at eight Transport Canada airfields in central Canada. The Pstd determined from the CROL test, Pcrol, was compared to the HWD deflection at the center of the HWD loading plate, the radius of curvature of the HWD deflection bowl, and the area of the HWD deflection bowl at loads of 60, 120, 180, and 240 kilonewtons. A relationship between the slope and intercept of the deflection bowl area versus HWD load plots and Pcrol with a correlation coefficient of about 0.84 was developed. This relationship is considered to be a viable method of estimating the Pstd from HWD data for airfields located in central Canada. Author (CISTI)

N94-31747# Laval Univ. (Quebec). Faculte des Sciences et Genie.
DEVELOPMENT OF A ROBOTIC SIMULATOR FOR STUDYING INTERFERENCE AND CONTACT PROBLEMS M.S. Thesis [DEVELOPPEMENT D'UN SIMULATEUR ROBOTIQUE POUR L'ETUDE DES PROBLEMES D'INTERFERENCE ET DE CONTACT]

GAETAN MICHAUD Sep. 1993 97 p In FRENCH
(ISBN-0-315-86705-1; CTN-94-61224) Copyright Avail: Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

Novel algorithms for studying the contact interference problem in robotics are developed with the objective of introducing them into a new approach for analyzing contact forces during grasping operations. A new approach for analyzing mechanical contacts is utilized for validation. With the aid of Winkler's method and interference algorithms, an analysis of two objects in contact is presented under three different conditions with respect to the types of surfaces which are in contact: a pointed object contacting a plane surface, an edge contacting another edge, and a cylinder contacting a plane surface. The study is based on one of the necessary conditions of the Winkler method, i.e. the analogy to volumetric interference, related to a material interpenetration between two objects. To incorporate the previous elements, a simulator and a data structure are developed. The simulator is used to validate the algorithm of detection of interference between a plane surface and a cylinder. CISTI

N94-32009 Arnold Engineering Development Center, Arnold AFS, TN.

DEVELOPMENT OF HIGH-PRESSURE DIAPHRAGMS FOR THE AEDC IMPULSE TUNNEL Final Report, 1 Oct. 1991 - 1 Oct. 1993
J. R. DEWITT Feb. 1994 29 p Prepared in cooperation with Calspan Corp., Arnold AFS, TN Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-A277053; AEDC-TR-93-28) Avail: CASI HC A03

Operation of the AEDC Impulse Tunnel at high stagnation conditions will require diaphragm burst pressures up to approxi-

09 RESEARCH AND SUPPORT FACILITIES (AIR)

mately 6,900 bars. A hemispherically shaped diaphragm design made of high-strength material has been developed and tested in a test rig for the pressure range from 1,400 to 6,800 bars. Flat diaphragms have been developed and used in the Impulse Tunnel at pressures up to 1,400 bars. A nearly linear relationship between the burst pressure and the ratio of remaining metal thickness to the radius of the cavity into which the diaphragm opens allows linear scaling to different size facilities. DTIC

N94-32014# Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.

MODULAR SIMULATOR SYSTEM (MSS) MANAGEMENT GUIDE Final Report

K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 48 p
(Contract F33657-86-C-0149)
(AD-A277098; S495-10459-1; ASC-TR-94-5008) Avail: CASI HC A03/MF A01

This document provides guidance and reference information for management personnel in the use of the Modular Simulator System (MSS) design principles. It identifies those unique management considerations required when employing the modular simulator design to a simulation and/or training device. This guide serves as both an educational and decision tool for the manager. The guide will educate the manager in the basic concepts of the modular simulator design and its basis for development. Key program decisions and considerations that must be made when using the modular simulator design are identified and discussed. The advantages and disadvantages of using the modular simulator design along with associated cost/risk analysis, logistics impacts, management implications, lessons learned and basis for invoking the modular simulator design on a procurement/program are provided. DTIC

N94-32120# Federal Aviation Administration, Atlantic City, NJ. Technical Center.

EVALUATION FOR THE DEVELOPMENT OF TAXIWAY LIGHTING INTENSITY STANDARDS

KEITH W. BAGOT Feb. 1994 15 p
(AD-A276706; DOT/FAA/CT-TN93/50) Avail: CASI HC A03/MF A01

The purpose of this evaluation was to gather data to produce taxiway lighting intensity standards to be incorporated into DOT/FAA Order 7110.65H, Air Traffic Control. Currently, there are no tables of standard intensity settings for taxiway lighting systems. Air traffic controllers are only instructed to operate the taxiway lights between sunset and sunrise and at other times they consider it necessary. DTIC

N94-32241 Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.

MODULAR SIMULATOR SYSTEM (MSS). EXECUTIVE REPORT Final Report

K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 72 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract F33657-86-C-0149)
(AD-A276966; S495-10441-1; ASC-TR-94-5006) Avail: CASI HC A04

This report provides an executive overview and top level presentation materials for the Modular Simulator System (MSS). It provides a brief overview of the MSS project, system architecture and design, and application alternatives for employing the design to a simulation and/or training device. This report serves as both an educational and decision tool for all levels of management and engineering personnel. This report describes the basic concept of the MSS design and its basis for development. The intent is to support informed decisions regarding the application of the MSS approach to a specific training system development. Additional sources for detailed MSS data are also provided for further reference. DTIC

N94-32311 Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.

MODULAR SIMULATOR SYSTEM (MSS). INTERFACE REQUIREMENTS SPECIFICATION FOR THE GENERIC MSS Final Report

K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 61 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract F33657-86-C-0149)
(AD-A276965; S495-10734-1; ASC-TR-94-5005) Avail: CASI HC A04

This document describes the interface requirements for the Modular Simulator System. Tailoring will be necessary to meet specific training system requirements. Specific tailoring instructions are included for each paragraph. It is suggested that the user read the 'Modular Simulator Engineering Design Guide' and the 'Modular Simulator Management Guide' prior to tailoring this specification. DTIC

N94-32312 Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.

MODULAR SIMULATOR SYSTEM (MSS). SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MSS-SYSTEM INTEGRATION, VOLUME 1 Final Report

K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 86 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract F33657-86-C-0149)
(AD-A276968; S495-10400D-VOL-1; ASC-TR-94-5010) Avail: CASI HC A05

This is the System Integration portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the 'Modular Simulator Engineering Guide' and the 'Modular Simulator Management Guide' prior to tailoring this volume. DTIC

N94-32313 Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.

MODULAR SIMULATOR SYSTEM (MSS). SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM-FLIGHT STATION MODULE, VOLUME 2 Final Report

K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 36 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract F33657-86-C-0149)
(AD-A276969; S495-10400D-VOL-2; ASC-TR-94-5011) Avail: CASI HC A03

This is the Flight Station portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the 'Modular Simulator Engineering Guide' and the 'Modular Simulator Management Guide' prior to this volume. DTIC

N94-32314# Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.

MODULAR SIMULATOR SYSTEM (MSS). SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM-RADAR MODULE, VOLUME 8 Final Report

K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug.

1993 34 p

(Contract F33657-86-C-0149)

(AD-A276975; S495-10400D-VOL-8; ASC-TR-94-5018) Avail:
CASI HC A03/MF A01

This is the Radar portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the 'Modular Simulator Engineering Guide' and the 'Modular Simulator Management Guide' prior to tailoring this volume. DTIC

N94-32315 Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.

MODULAR SIMULATOR SYSTEM (MSS). SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM-ELECTRONIC WARFARE MODULE, VOLUME 9 Final Report

K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 33 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract F33657-86-C-0149)

(AD-A276976; S495-10400D-VOL-9; ASC-TR-94-5019) Avail:
CASI HC A03

This is the Electronic Warfare portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the 'Modular Simulator Engineering Guide' and the 'Modular Simulator Management Guide' prior to tailoring this volume. DTIC

N94-32316 Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.

MODULAR SIMULATOR SYSTEM (MSS). SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM-PHYSICAL CUES MODULE, VOLUME 10 Final Report

K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 33 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract F33657-86-C-0149)

(AD-A276977; S495-10400D-VOL-10; ASC-TR-94-5020) Avail:
CASI HC A03

This is the Physical Cues portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the 'Modular Simulator Engineering Guide' and the 'Modular Simulator Management Guide' prior to tailoring this volume. DTIC

N94-32317 Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.

MODULAR SIMULATOR SYSTEM (MSS). SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM-VISUAL MODULE, VOLUME 11 Final Report

K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 55 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract F33657-86-C-0149)

(AD-A276978; S495-10400D-VOL-11; ASC-TR-94-5021) Avail:

CASI HC A04

This is the Visual portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the 'Modular Simulator Engineering Guide' and the 'Modular Simulator Management Guide' prior to tailoring this volume. DTIC

N94-32318# Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.

MODULAR SIMULATOR SYSTEM (MSS). SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM-INSTRUCTOR/OPERATOR STATION MODULE, VOLUME 12 Final Report

K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 42 p

(Contract F33657-86-C-0149)

(AD-A276979; S495-10400D-VOL-12; ASC-TR-94-5022) Avail:
CASI HC A03/MF A01

This is the Instructor/Operator Station portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the 'Modular Simulator Engineering Guide' and the 'Modular Simulator Management Guide' prior to tailoring this volume. DTIC

N94-32319 Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.

MODULAR SIMULATOR SYSTEM (MSS). SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM-ENVIRONMENT MODULE, VOLUME 13 Final Report

K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 34 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract F33657-86-C-0149)

(AD-A276980; S495-10400D-VOL-13; ASC-TR-94-5023) Avail:
CASI HC A03

This is the Environment portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the 'Modular Simulator Engineering Guide' and the 'Modular Simulator Management Guide' prior to tailoring this volume. DTIC

N94-32394# Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.

MODULAR SIMULATOR SYSTEM (MSS). ENGINEERING DESIGN GUIDE Final Report

K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 86 p

(Contract F33657-86-C-0149)

(AD-A276967; S495-10440-1; ASC-TR-94-5007) Avail: CASI HC
A05/MF A01

This document is intended as an engineering guide for designing a modular simulator. This guide addresses the definition, history, and characteristics of a modular simulator. Systems and software engineering activities are defined, and modular simulator segment specific and networking design considerations are discussed. This

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document discusses the modular simulator program design goals and rationale, design rules and guidelines, and lessons learned that have evolved through the program's demonstration phase. The effective use of this guide, in conjunction with the modular simulator architecture documents referenced herein, can substantially reduce the cost, schedule, and risk involved in developing a modular simulator. DTIC

N94-32395# Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.
MODULAR SIMULATOR SYSTEM (MSS). SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM-FLIGHT CONTROLS MODULE, VOLUME 3 Final Report
K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 41 p
(Contract F33657-86-C-0149)
(AD-A276970; S495-10400D-VOL-3; ASC-TR-94-5013) Avail: CASI HC A03/MF A01

This is the flight controls portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specification aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the 'Modular Simulator Engineering Guide' and the 'Modular Simulator Management Guide' prior to tailoring this volume. DTIC

N94-32396# Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.
MODULAR SIMULATOR SYSTEM (MSS). SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM-FLIGHT DYNAMICS MODULE, VOLUME 4 Final Report
K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 36 p
(Contract F33657-86-C-0149)
(AD-A276971; S495-10400D-VOL-4; ASC-TR-94-5014) Avail: CASI HC A03/MF A01

This is the flight dynamics portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the 'Modular simulator Engineering Guide' and the 'Modular Simulator Management Guide' prior to tailoring this volume. DTIC

N94-32397# Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.
MODULAR SIMULATOR SYSTEM (MSS). SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM-PROPULSION MODULE, VOLUME 5 Final Report
K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 41 p
(Contract F33657-86-C-0149)
(AD-A276972; S495-10400D-VOL-5; ASC-TR-94-5015) Avail: CASI HC A03/MF A01

This is the propulsion portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been

replaced by application specific text or deleted from the specification. It is suggested that the user read the 'Modular Simulator Engineering Guide' and the 'Modular Simulator Management Guide' prior to tailoring this volume. DTIC

N94-32398# Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.
MODULAR SIMULATOR SYSTEM (MSS). SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM-NAVIGATION/COMMUNICATION MODULE, VOLUME 6 Final Report
K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 34 p
(Contract F33657-86-C-0149)
(AD-A276973; S495-10400D-VOL-6; ASC-TR-94-5016) Avail: CASI HC A03/MF A01

This is the navigation/communication portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the 'Modular Simulator Engineering Guide' and the 'Modular Simulator Management Guide' prior to tailoring this volume. DTIC

N94-32399# Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.
MODULAR SIMULATOR SYSTEM (MSS). SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM-WEAPONS MODULE, VOLUME 7 Final Report
K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 38 p
(Contract F33657-86-C-0149)
(AD-A276974; S495-10400D-VOL-7; ASC-TR-94-5017) Avail: CASI HC A03/MF A01

This is the weapons portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the 'Modular Simulator Engineering Guide' and the 'Modular Simulator Management Guide' prior to tailoring this volume. DTIC

N94-32403 Boeing Defense and Space Group, Huntsville, AL. Simulation and Training Systems.
MODULAR SIMULATOR SYSTEM (MSS): INTERFACE DESIGN DOCUMENT FOR THE GENERIC MSS Final Report
K. KELLY, J. BROWN, G. KAMSICKAS, and W. TUCKER 20 Aug. 1993 474 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract F33657-86-C-0149)
(AD-A277270; S495-10735-1; ASC-TR-94-5009) Avail: CASI HC A20

This document describes the detailed design for the interfaces associated with the Modular Simulator System. Tailoring will be necessary to meet specific training system requirements. Specific tailoring instructions are included for each paragraph. It is suggested that the user read the 'Modular Simulator Engineering Design Guide' and the 'Modular Simulator Management Guide' prior to tailoring this document. DTIC

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ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

N94-32295 George Washington Univ., Washington, DC.
COMPUTATIONAL METHODS FOR FRICTIONAL CONTACT WITH APPLICATIONS TO THE SPACE SHUTTLE ORBITER NOSE-GEAR TIRE Ph.D. Thesis

JOHN A. TANNER 1993 210 p

Avail: Univ. Microfilms Order No. DA9313716

A computational procedure has been presented for the solution of frictional contact problems for aircraft tires. The Space Shuttle nose gear tire was modeled using a two-dimensional laminated anisotropic shell theory with the effects of variation in material and geometric parameters, transverse-shear deformation, and geometric nonlinearities included. The contact conditions were incorporated into the formulation by using a perturbed Lagrangian approach with the fundamental unknowns consisting of the stress resultants, the generalized displacements, and the Lagrange multipliers associated with the contact and friction conditions. The contact-friction algorithm was based on a modified Coulomb friction law. The elemental arrays were obtained by using a modified two-field, mixed variational principle. The modification consisted of augmenting the functional of that principle by two terms: the Lagrange multiplier vector associated with nodal normal and tangential contact load intensities and a regularization term which was quadratic in the Lagrange multiplier vector. Experimental measurements were made to define the response of the Space Shuttle nose-gear tire to inflation pressure loads and to combined inflation pressure loads and static normal loads against a rigid flat plate. These experimental results describe meridional growth of the tire cross section due to inflation loading, the static load-deflection characteristics of the tire, the geometry of the tire footprint under the static loading conditions, and the normal and tangential load intensity distributions in the tire footprint for the various static vertical loading conditions. Numerical results were obtained for the Space Shuttle nose-gear tire subjected to inflation pressure loads and combined inflation pressure and contact loads against a rigid flat plate. Comparisons were made between the experimental measurements and the numerical results.

Dissert. Abstr.

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CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

N94-31892 Diffracto Ltd., Windsor (Ontario).
LOCATION OF IMPACT DAMAGE SITES IN COMPOSITE AIRCRAFT STRUCTURES, TASK 3.4.1 Final Report
FRANK KARPALA and OMER L. HAGENIERS Dec. 1992 19 p
(DSIS-94-01590; CTN-94-61258) Avail: CASI HC A03/MF A01

A portable field-level inspection system called D Sight was developed to isolate areas of a composite aircraft structure that may have been damaged by low-energy impact. An extensive laboratory program was set up to determine factors which influence the

correlation between D Sight indication and subsurface delamination. The program also demonstrated the applicability of D Sight to the wide range of materials, lay-ups, coatings, and structures that are potentially inspectable. The D Sight concept was tested on CF-18 composite structures under in-service conditions, including a study of various paint schemes. A second phase of the project addressed the development and evaluation of an advanced development model leading to the definition of those factors important in a commercial product. The project verified that D Sight can detect low-energy impact damage in aircraft structures at a level below that detectable by normal human visual inspection. The project also resulted in a D Sight Aircraft Inspection System that can be used in field evaluations for further definition of the design needs of a field deployable impact damage inspection system. CISTI

N94-32047# Pratt and Whitney Aircraft, West Palm Beach, FL.
Government Engines and Space Propulsion.

FATIGUE IN SINGLE CRYSTAL NICKEL SUPERALLOYS

CHARLES ANNIS and DANIEL P. DELUCA 15 Feb. 1994 9 p
(AD-A276662; PW/GESP-FR21998-22) Avail: CASI HC A02/MF A01

This program investigates the seemingly unusual behavior of single crystal airfoil materials. The fatigue initiation processes in single crystal (SC) materials are significantly more complicated and involved than fatigue initiation and subsequent behavior of a (single) macrocrack in conventional, isotropic, materials. To understand these differences is the major goal of this project. DTIC

N94-32150# Pennsylvania State Univ., University Park.

ADVANCED THERMALLY STABLE JET FUELS

H. H. SCHOBERT, S. ESER, C. SONG, P. G. HATCHER, P. M. WALSH, and M. M. COLEMAN Jul. 1993 124 p
(Contract DE-FG22-92PC-92104)

(DE94-006760; DOE/PC-92104/T3) Avail: CASI HC A06/MF A02

This project was initiated on August 1, 1992. The starting date resulted in this project being one month out of synchronization with the normal quarterly calendar (i.e., January, April, July, and October). On advice of Mr. John Augustine, DOE/PETC, the present report is prepared to cover only two months work, so that future quarterly reports will be aligned with the conventional reporting schedule. A significant pressure dependence was observed for the pyrolysis of n-tetradecane at 450 C for 30 min. It appears that at least two processes are affected by the reactant pressure, but in opposite directions. The influence of inert gas pressure is dependent on both the initial sample volume and the pressure range. However, when the inert gas pressure is within a certain specific range, the changes in the sample volume have no impact on n-tetradecane conversion. Below or above this range, increasing inert gas pressure can either decrease or increase conversion, depending on the sample volume. DOE

N94-32184# Army Belvoir Research and Development Center, Fort Belvoir, VA.

STATUS OF DEVELOPING A MULTIFUNCTIONAL AVIATION GREASE Final Report

IN-SIK RHEE Jan. 1994 29 p

(AD-A276755; BRDEC-2546) Avail: CASI HC A03/MF A01

A program has been initiated to develop a new multifunctional helicopter grease. The purpose for the development of this new grease is to provide a product having significantly improved performance, reduce the overall logistics and supply burdens, reduce procurement costs, and control the continuing increase in proliferation of proprietary non-standard products. The effort during FY-91 -

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FY-92 was devoted to determine the preliminary target requirements and to formulate the experimental grease. In these efforts, the preliminary target requirements were developed based on what is believed to be achievable with current technology versus projected system requirements. Based on these preliminary target requirements, the experimental greases were formulated using an advanced lithium complex technology as thickener and a mix polyalphaolefin (PAO) synthetic base oil, a small amount of high viscosity mineral oils, and various additives. On the basis of the work completed to date, the experimental greases were very close to meeting the preliminary target requirements and are promising as the candidate aviation greases. DTIC

N94-32265 Aeronautical Research Labs., Melbourne (Australia). ASSESSMENT OF IMPACT DAMAGE IN COMPOSITE STRUCTURES

R. JONES, S. C. GALEA, and J. J. PAUL Dec. 1993 61 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-A277063; ARL-TR-23; DODA-AR-008-409) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

In order to provide through-life support for structural components fabricated from advanced composite materials, it is desirable to establish a damage tolerance methodology. There are many difficulties in meeting this objective, including the multiplicity of failure modes, the numerous types of potentially significant defects which may arise during manufacture or in service, and the sensitivity to moisture and temperature. This paper focuses on the problem of impact damage and reviews research undertaken at ARL in recent years related to the analysis and testing of impact damage composite laminates. It is shown that the residual strength of impact damaged laminates reduces to an asymptotic limit as the size of the damage increases and that uniaxial S-N curves for damaged laminates have a generic shape with a pronounced threshold (endurance) level. DTIC

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ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

N94-30484*# Wright Lab., Wright-Patterson AFB, OH. USE OF MAGNETIC COMPRESSION TO SUPPORT TURBINE ENGINE ROTORS

CHRIS J. POMFRET In NASA, Washington, Technology 2003: The Fourth National Technology Transfer Conference and Exposition, Volume 1 p 395-410 Feb. 1994 Avail: CASI HC A03/MF A04

Ever since the advent of gas turbine engines, their rotating disks have been designed with sufficient size and weight to withstand the centrifugal forces generated when the engine is operating. Unfortunately, this requirement has always been a life and performance limiting feature of gas turbine engines and, as manufacturers strive to meet operator demands for more performance without increasing weight, the need for innovative technology has become more important. This has prompted engineers to consider a fundamental and radical breakaway from the traditional design of turbine and compressor disks which have been in use since the first jet engine was flown 50 years ago. Magnetic compression aims to counteract, by direct opposition rather than restraint, the centrifugal forces generated within the engine. A magnetic coupling is created between a rotating disk and a stationary superconducting coil to create a massive inwardly-directed magnetic force. With the centrifugal forces opposed by an equal and opposite magnetic force, the large heavy disks could be dispensed with and replaced with a torque tube to hold the blades. The proof of this concept has been

demonstrated and the thermal management of such a system studied in detail; this aspect, especially in the hot end of a gas turbine engine, remains a stiff but not impossible challenge. The potential payoffs in both military and commercial aviation and in the power generation industry are sufficient to warrant further serious studies for its application and optimization. Author (revised)

N94-30756 National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

EULER RESULTS OF THE ISNAS COMPRESSIBLE MULTI-BLOCK FLOW SOLVER

W. WAGENAAR and M. E. S. VOGELS 30 Oct. 1992 24 p Presented at the 5th ISNaS Symposium, Twente, Netherlands, 5-6 Nov. 1992 Sponsored by Ministry of Education and Sciences, and Ministry of Transport and Public Works Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-B179299; NLR-TP-92443-U; ETN-94-95963) Avail: CASI HC A03

The development of a multizone multiblock Navier-Stokes flow solver, directed towards the multielement airfoil application, for the ISNaS, an Information System for flow simulation based on the Reynolds averaged Navier-Stokes equations, is addressed. In the pipeline of the flow solver special editors support the input preparation. The development and test approach for the Euler computational kernel are described. Euler results for the flow solver are discussed to the level of verification. It is demonstrated that the flow solver gives flow results for the multielement airfoil application. The starting point of the validation of the flow solver was reached. Further development will involve validation, performance acceleration, and addition of new models, algorithms, and boundary types. ESA

N94-30763 National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

INFORMATION SYSTEM FOR FLOW SIMULATION BASED ON THE NAVIER-STOKES EQUATIONS VECTORIZATION

P. A. VANMOURIK 26 Feb. 1993 38 p Presented at Negende Supercomputer-Gebruikersdag, Amsterdam, Netherlands, 17 Dec. 1992 Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-B179293; NLR-TP-93082-U; ETN-94-95969) Avail: CASI HC A03

The vectorization of a multiblock Navier-Stokes solver on the NEC SX-3 supercomputer is described. The flow solver under consideration was developed in a project, resulting in ISNaS, an Information System for flow simulation based on the Reynolds averaged Navier-Stokes equations, of which the flow solver is a part. With this solver it is possible to calculate three dimensional flows around multielement airfoil geometries with extended flaps and slats. ESA

N94-30807 California Univ., Davis.

THE EFFECT OF PRESSURE GRADIENT ON THE STRUCTURE OF AN EQUILIBRIUM TURBULENT BOUNDARY LAYER Ph.D. Thesis

TING-KWO LEI 1993 157 p

Avail: Univ. Microfilms Order No. DA9328854

Hot-wire anemometry was used to study the effect of adverse pressure gradient on the large-scale structures of equilibrium turbulent boundary layers. A previously existing zero-pressure gradient wind tunnel was modified into an adverse-pressure gradient wind tunnel, which had the capability of creating designated adverse-pressure gradient equilibrium turbulent boundary layer flows. The range of the equilibrium parameter beta was from 0.0 to 1.8 along a 1.50 m long test section of the wind tunnel. Computer programs were developed to predict the geometric shape of the test section for an equilibrium adverse-pressure gradient turbulent boundary layer flow. The numerical prediction of the test section geometry was found to be satisfactory and a substantial effort was saved in the establishment of an equilibrium boundary layer. Three equilibrium boundary layer flows at values of beta = 0.0, 0.8, and 1.8, which

respectively represents zero, mild, and strong adverse pressure gradient, were established and were found to be suitable for turbulence structure measurements. Space-time correlation measurements were carried out to determine the convection velocities and inclination angles of the large-scale structures for the three different pressure gradient cases. The convection velocity measurements were performed at various heights which ranged from $y(\text{sup}) = 225$ to 525 for each beta value. It was found that, within the range of height of the measurements, the convection velocity was independent of height. In the case of the strong adverse-pressure gradient flow, the convection velocity was observed to be much lower than the convection velocity observed in the case of zero-pressure gradient. In the case of the mild-pressure gradient flow, it was observed that the pressure gradient effect on the convection velocity was negligible as compared to the zero-pressure gradient case. The inclination angle in the case of strong-pressure gradient case was found to be much greater than that observed in the case of zero-pressure gradient case. The pressure gradient effect on the inclination angle was observed to be negligible in the case of mild adverse-pressure gradient case. Dissert. Abstr.

N94-30809 Texas A&M Univ., College Station.

ROTOR INSTABILITY INDUCED BY DEAD BAND CLEARANCE IN BEARING SUPPORTS Ph.D. Thesis

YAO-QUN LIN 1993 203 p

Avail: Univ. Microfilms Order No. DA9328763

Rotor instability, or rotor nonsynchronous natural frequency vibration, is of major concern in the rotor dynamics field. Efforts have been made continuously to explain this phenomenon since it was identified more than seventy years ago. To date, rotor instability vibration has been almost ascribed to two mechanisms, i.e., internal friction effects and fluid actions. It has been predicted by some investigations that dead band clearance in bearing supports can induce only sub and/or super harmonics tracking the synchronous speed and does not cause the nonsynchronous (non-harmonic) natural frequency vibration. It is shown, however, in this dissertation that dead band clearance in ball bearing supports can induce rotor nonsynchronous natural frequency vibration. The computer simulations show that in a limited speed range, the ball-bearing outer race of an unbalanced rotor may leave (tight-loose) then touch (loose-tight) the housing surface and induce an internal impact. Internal impacts will excite the natural frequency vibration of the rotor, which is independent of the rotor synchronous vibration and will reach a limit cycle due to system's damping. Beyond the speed range, the nonsynchronous natural frequency disappears. Half-frequency vibration is also predicted by the computer simulations. It is shown that the half-frequency vibration is induced by the nonlinear coupling between the equations of motion due to dead band clearance. Experiments with a rotor supported on ball bearings with dead band clearance are conducted. The experimental results agree well with the theoretical predictions. The nonsynchronous natural frequency vibration of ball-bearing supported rotors (without seals) has been traditionally explained as internal friction induced rotor instability. The classical internal friction theory is discussed in this dissertation. It is claimed here that what is predicted by the classical linear theory on internal friction is a divergent (Liapunov unstable) response and hence is unmeasurable. But rotor instability vibration, which has two significant components at the synchronous and the natural frequencies, is measurable and hence is Liapunov stable. Dissert. Abstr.

N94-30816 California Univ., Los Angeles.

MIXED EULERIAN-LAGRANGIAN FINITE ELEMENT SOLUTIONS OF UNSTEADY FLOW AND FLUTTER IN TRANSONIC CASCADE Ph.D. Thesis

CHINGTENG HSIAO 1993 212 p

Avail: Univ. Microfilms Order No. DA9319918

Unsteady flow and flutter phenomena of turbomachinery cascades operating in the transonic regime are explored by a new numerical approach. The two dimensional unsteady Euler equations are used to model the transonic cascade flows, and the cascade blades are modeled as thin plates. To minimize the discretization

incompatibility, both the fluid and the solid domains are discretized using finite element procedures. The Rayleigh-Ritz finite element formulations are employed in the structural discretization while the Galerkin finite element procedure is used in the fluid discretization. As is customary, the discretized equations of the cascade blades are described in purely Lagrangian coordinates. However, in order to take care of the time-varying boundary conditions effectively, the mixed Lagrangian-Eulerian description is used in the fluid domain. The fluid and the structural models are coupled by introducing a channel theory, which is equivalent to a strip theory in the classical sense. In this procedure several two dimensional aerodynamic solvers are combined with one three dimensional structural solver to form a quasi three dimensional aeroelastic system. The whole system is marched toward in time using an explicit four-stage Runge-Kutta scheme to obtain the time domain solutions. Steady and unsteady transonic flow results are both presented. The current finite element Euler solutions show very good agreement with available finite volume Euler solutions. Free vibration analyses of nonrotating and rotating blades using the present finite element model with 80 degrees of freedom have been carried out. The computed natural frequencies and mode shapes are comparable to other finite element and Rayleigh-Ritz results. Aeroelastic responses of several cascade configurations in different transonic flow fields are investigated using either a typical section model or the present quasi three dimensional model. These analyses demonstrate that the current full blade structure formulation can handle flutters involving higher modes and hence have a better estimation of the flutter boundary. Dissert. Abstr.

N94-31209 California Univ., San Diego.

THE EFFECT OF AN AXIAL FLOW COMPONENT ON A CIRCULAR CYLINDER WAKE Ph.D. Thesis

CHRISTINE GLADDING LEWIS 1993 130 p

Avail: Univ. Microfilms Order No. DA9317509

A series of experiments were conducted to determine what effect a variation in the level of streamwise vorticity would have on the wake of a bluff body. These experiments investigate changes in wake dynamics caused by the introduction of a steady spanwise component of flow, which creates a steady influx of streamwise vorticity. To accomplish this, a cylinder in a uniform flow field is suddenly moved at constant velocity in the spanwise direction. The steady state flow condition is studied. The control cylinder technique is used to control the end conditions, to make the unperturbed flow parallel. Two primary modes of shedding are observed in the laminar cylinder wake, depending on the ratio of the axial cylinder velocity to the uniform flow velocity (V/U). For ratios of V/U less than four, oblique laminar shedding occurs. The direction and angle of the oblique shedding are controlled by the sign and magnitude of the ratio V/U . For larger ratios of V/U , shedding occurs in the form of trailing vortices. At a critical ratio of V/U , the vortex sheet appears to breakdown, and spectra are completely broadband. The steady-state motion can be compared, via Galilean transformation, to that of the yawed cylinder in a steady flow. Oblique shedding and trailing vortices have also been observed in yawed cylinder wakes. The relationship between shedding angle, frequency, wavelength, mean vorticity, and V/U is discussed. These results are compared to relationships found to occur in naturally occurring oblique shedding and to yawed cylinder results. Dissert. Abstr.

N94-31211 Michigan Univ., Ann Arbor.

RESPONSE OF WALL TURBULENCE TO HIGH FREQUENCY STREAMWISE AND SPANWISE OSCILLATIONS Ph.D. Thesis

WEN-JE JUNG 1993 200 p

Avail: Univ. Microfilms Order No. DA9319555

In an attempt to gain a better understanding of the dynamics of nonequilibrium turbulent wall flows, the response of wall turbulence to two classes of perturbations, namely, streamwise oscillations and spanwise oscillations, has been investigated by direct numerical simulation. Nondimensional periods of oscillation, $T(\text{sub osc})(\text{sup}) = T(\text{sub osc}) u(\text{sub tau})(\text{exp } 2)/\nu$, ranging from 25 to 2000 and amplitudes of oscillation ranging from 30 to 80 percent have been

studied. Significant suppression of turbulence is observed with spanwise oscillations at $T(\text{sub osc})(\text{sup } +) = 100$, which is accompanied by reductions of 60 percent in the overall turbulence production and 40 percent in the turbulent drag. Analysis of the dynamics of near-wall turbulence structures reveals that these reductions are due to a continual shift of near wall streamwise vortices relative to the wall layer streaks. In the case of streamwise oscillations, no net reduction was observed at any of the frequencies investigated. The dynamics of the flow in the presence of both classes of oscillations has been classified in terms of the value of the nondimensional periods of oscillation $T(\text{sub osc})(\text{sup } +)$. Dissert. Abstr.

N94-31217 Iowa State Univ. of Science and Technology, Ames.
A SOLUTION ADAPTIVE STRUCTURED-UNSTRUCTURED GRID PROCEDURE FOR UNSTEADY FLOWS Ph.D. Thesis
SANJAY R. MATHUR 1993 112 p
Avail: Univ. Microfilms Order No. DA9321195

A solution adaptive hybrid grid method for the computation of 2-D, unsteady flows is presented. The method is capable of handling multiple component, complex geometries in relative motion, such as those encountered in turbomachinery analysis. The numerical approach uses a hybrid structured-unstructured zonal grid topology along with modeling equations and solution techniques that are most appropriate in the individual domains, thus, combining the advantages of both structured and unstructured grid methods. The viscous flow region in the immediate vicinity of the airfoils is resolved using a third order accurate, implicit, upwind solution of the Navier-Stokes equations on structured, O-type grids. Explicit solutions of the Euler equations are obtained in the rest of the domain that consists of an unstructured mesh made up of triangular cells. The use of both central- and upwind-difference flux schemes is investigated for the unstructured domains. Methodologies for accurate, conservative transfer of information at the interface between the structured and unstructured domains as well as that between two unstructured grid regions. Both time-averaged and time-resolved results are presented for test cases and are compared with available experimental data. The quality of the results obtained by the present method is comparable with those obtained by methods based on fully structured grids. Calculations performed using the solution adaptation capabilities are also presented. Dissert. Abstr.

N94-31229* National Aeronautics and Space Administration.
Lewis Research Center, Cleveland, OH.
COMPUTATIONAL STUDY OF SINGLE-EXPANSION-RAMP NOZZLES WITH EXTERNAL BURNING
SHAYE YUNGSTER and CHARLES J. TREFNY Apr. 1992 28 p
Presented at the 32nd Aerospace Sciences Meeting, Reno, NV, 10-13 Jan. 1994
(Contract NCC3-233; RTOP 505-90-5R)
(NASA-TM-106550; ICOMP-94-5; E-8702; NAS 1.15:106550; AIAA PAPER 94-0024) Copyright Avail: CASI HC A03/MF A01

A computational investigation of the effects of external burning on the performance of single expansion ramp nozzles (SERN) operating at transonic speeds is presented. The study focuses on the effects of external heat addition and introduces a simplified injection and mixing model based on a control volume analysis. This simplified model permits parametric and scaling studies that would have been impossible to conduct with a detailed CFD analysis. The CFD model is validated by comparing the computed pressure distribution and thrust forces, for several nozzle configurations, with experimental data. Specific impulse calculations are also presented which indicate that external burning performance can be superior to other methods of thrust augmentation at transonic speeds. The effects of injection fuel pressure and nozzle pressure ratio on the performance of SERN nozzles with external burning are described. The results show trends similar to those reported in the experimental study, and provide additional information that complements the experimental data, improving our understanding of external burning flowfields. A study of the effect of scale is also presented. The results indicate that combustion kinetics do not make the flowfield sensitive to scale. Author

N94-31333# Naval Postgraduate School, Monterey, CA.
ROTORDYNAMIC EFFECTS DRIVEN BY FLUID FORCES FROM A GEOMETRICALLY IMPERFECT LABYRINTH M.S. Thesis
WILLIAM C. WILLISTON, JR. Dec. 1993 43 p
(AD-A276424) Avail: CASI HC A03/MF A01

The forces on a rotor due to asymmetric pressure distributions resulting from a single gland non-circular labyrinth seal in a circular outer casing are analyzed for the purpose of understanding the possible causes of synchronous vibration due to seal intolerance. A lumped parameter model is developed for flow in the azimuthal direction inside the seal gland. The sealing knife imperfections causing the non-circularity may be due to manufacturing defects or in service wear. The resulting continuity and momentum equations are solved using a regular linear perturbation technique. Results from this model indicate under what conditions seal imperfections can generate forces of the same order of magnitude as rotor mass unbalance. DTIC

N94-31384# State Univ. of New York, Stony Brook. Dept. of Electrical Engineering.
COMMUNICATIONS NETWORKS IN STRESSED ENVIRONMENTS Final Report, 1 Jan. 1991 - 31 Dec. 1993
STEPHEN S. RAPPAPORT and T. G. ROBERTAZZI 31 Dec. 1993 10 p
(Contract N00014-91-J-4063)
(AD-A275967) Avail: CASI HC A02/MF A01

Communications techniques and performance models are devised for communications networks in which mobile platforms, volatile traffic patterns, and interference are significant features. The main focus is on network organization and control configurations that support communications among semi-autonomous mobile platforms. Example platforms can support data gathering sensors and communications equipment aboard guided or maneuverable space vehicles satellites, aircraft, ships, or grounded vehicles or persons. Network configurations with limited and/or shared communications resources are considered. Analytical models are devised to characterize major performance issues. Matters of concern include maintaining network connectivity with mobile platforms that have active communications links, methods for allocating communications resources to gateways, dynamic assignment of resources, and access rights. Topics investigated have included: acquisition of spread spectrum signals, low-delay channel access protocols, call hand-off schemes, telecommunications traffic performance of mobile networks, computation vs. communication considerations, high speed packet switching, and aspects of self-organizing communications networks. DTIC

N94-31476# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Oceanengineering.
THREE-DIMENSIONAL VELOCITY MEASUREMENTS ON A 6:1 PROLATE SPHEROID AT 10 DEG ANGLE OF ATTACK
CHRISTOPHER J. CHESNAKAS, ROGER L. SIMPSON, and MICHAEL M. MADDEN 18 Jan. 1994 230 p Revised
(Contract N00014-91-J-1732)
(AD-A276485; VPI-AOE-202-REV) Avail: CASI HC A11/MF A03

The flow in the cross flow separation region of a 6:1 prolate spheroid at 10 degrees angle of attack, $Re(\text{sub } L) = 4.20 \times 10^6$ (exp 6), was investigated using a novel three dimensional fiber optic laser doppler velocimeter (LDV). The probe was used to measure three simultaneous, orthogonal velocity components from within the model. The design and operation of this LDV probe is described and velocity, Reynolds stress, and velocity triple product measurements are presented from the inner boundary layer through the boundary layer edge. DTIC

N94-31575 Technische Univ., Berlin (Germany). Fachbereich Verkehrswesen.
APPLICABLE DIMENSIONING AND MEASURE AND TECHNOLOGICAL EXAMINATION OF LONG STATOR-LINEAR MOTORS FOR MAGNETIC HIGH-SPEED RAILWAYS Ph.D.

Thesis [ANWENDUNGSNAHE DIMENSIONIERUNG UND MESSTECHNISCHE UEBERPRUEFUNG VON LANGSTATOR-LINEARMOTOREN FUER MAGNETSCHNELLBAHNEN]
 RUEDIGER FUERST 1993 281 p In GERMAN Limited
 Reproducibility: More than 20% of this document may be affected by microfiche quality
 (Contract BMFT-TV8202/8406)
 (ETN-94-95734) Avail: CASI HC A13

Results of measurements aimed at verification of the characteristic magnitudes of long stator/linear motors are presented. Both TRANSRAPID 06 and 07 vehicles were used for tests and the maximal velocity reached 435 km/h. Stator current and voltage, effective power, efficiency, power factor and electromotive force were measured for all dynamic states of the vehicle: acceleration, inertial cruise and braking. The results were discussed in the case of perturbations and incidents of the linear motor, such as electrical short circuits in the long stator winding. Requirements for dimensioning the linear motor were identified and the influence of stator and excitation parameters on the curve electromotive force versus velocity was estimated. ESA

N94-31683# National Inst. of Standards and Technology, Boulder, CO. Electromagnetic Fields Div.
APERTURE EXCITATION OF ELECTRICALLY LARGE, LOSSY CAVITIES
 D. A. HILL, J. W. ADAMS, M. T. MA, A. R. ONDREJKA, and B. F. RIDDLE Sep. 1993 81 p
 (PB94-145711; NIST/TN-1361) Avail: CASI HC A05/MF A01

The document presents a theory based on power balance for aperture excitation of electrically large, lossy cavities. The theory yields expressions for shielding effectiveness, cavity Q, and cavity time constant. In shielding effectiveness calculations, the incident field can be either a single plane wave or a uniformly random field to model reverberation chamber or random field illumination. The Q theory includes wall loss, absorption by lossy objects within the cavity, aperture leakage, and power received by antennas within the cavity. Extensive measurements of shielding effectiveness, cavity Q, and cavity time constant were made on a rectangular cavity, and good agreement with theory was obtained for frequencies from 1 to 18 GHz. NTIS

N94-31707# Montreal Univ. (Quebec). Dept. de Genie Metal-lurgique.
THERMAL-MECHANICAL FATIGUE CRACK GROWTH IN AIRCRAFT ENGINE MATERIALS Ph.D. Thesis
 YI DAI May 1993 353 p
 (ISBN-0-315-86543-1; CTN-94-61209) Copyright Avail: Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

A thermal mechanical fatigue (TMF) testing rig was built which is capable of studying the fatigue behaviors of gas turbine engine materials under simultaneous changes of temperatures and strains or stress. An advance alternating current potential drop (ACPD) measurement system was also developed which is capable of performing on-line monitoring of fatigue crack initiation and growth in specimen testing under isothermal and TMF conditions. Fatigue crack initiation and short crack growth data were obtained for titanium alloy specimens designed with notch features associated with bolt holes of compressor discs. TMF data were also obtained for two titanium alloys used in aircraft engine components. Those data explained the material fatigue behavior encountered in full-scale component testing. A complete fractographic analysis was performed on the tested specimens enhancing the understanding of the fatigue crack growth mechanisms and helping to formulate an analytical crack growth model. The ACPD fatigue crack monitoring technique was applied to the low cycle fatigue testing of Pratt & Whitney 1480 monocrystalline nickel alloy. A completely automated, computer controlled test procedure was developed which could obtain crack initiation and growth data with greater speed, precision, and reliability than previous methods. Author (CISTI)

N94-31804* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

HIGH TEMPERATURE NASP ENGINE SEAL DEVELOPMENT (Videotape)

1992 Videotape: 6 min. 25 sec. playing time, in color, with sound (NASA-TM-109750; NONP-VT-94-9950) Avail: CASI VHS A01/BETA A22

This video details research being conducted at the Lewis Research Center on high temperature engine seal design for the National Aerospace Plane. To maximize the speed, the jets on the NASP extract oxygen from the air rather than carry large liquid fuel tanks; this creates temperatures within the jet of over 5000 F. To prevent these potentially explosive gases from escaping, researchers are developing new technologies for use in the engine seals. Two examples explained are the ceramic wafer seal and the braided ceramic rope seal. Computer simulations and laboratory footage are used to illustrate the workings of these seals. Benefits for other aerospace and industrial applications, as well as for the space shuttle, are explored. CASI

N94-31843 Stevens Inst. of Tech., Hoboken, NJ.
COMPUTATIONAL STUDY OF SIMULTANEOUS HEAT AND MASS TRANSFER IN TURBULENT SEPARATED FLOWS Ph.D. Thesis

ABDELGHANI ZIGH 1993 196 p
 Avail: Univ. Microfilms Order No. DA9328536

Many real problems of engineering interest contain regions of highly turbulent flow that exhibit separation and recirculation. An understanding of heat and mass transfer characteristics in these regions is of considerable importance in industrial practice. In this study, a finite volume numerical method is developed and utilized for the prediction and analysis of flow over a cascade of turbine blades involving simultaneous heat and mass transfer. The renormalization group (RNG) approach based nonlinear k-epsilon turbulence model is utilized to describe the flow field. The computational procedure involves the simultaneous solution of the time averaged equations of motion, heat, mass, and turbulent kinetic energy and its dissipation in generalized body-fitted coordinates. The first part of this study is aimed at the development of an algorithm and its validation through the analysis of a number of benchmark test cases. These include the turbulent flow with and without heat transfer downstream of an abrupt channel expansion, turbulent flows in the wake of a flat plate and isolated airfoils, and flow past airfoil cascades with and without trailing edge separation. The results are compared with the available experimental data and shown to be in excellent agreement. The second part involved parametric study of the transpiration cooling of a turbine blade cascade. Flow past turbine blade cascades with simultaneous heat and mass transfer are analyzed for Reynolds numbers from 5×10^5 to 2×10^6 and flow angles from -30 deg to 55 deg. The effects of the separation were appreciable in the suction side and the Nusselt and Sherwood numbers in the separation zone reached a maximum at the reattachment point. It is found that the behavior of the separated shear layer plays an important part upon the heat transfer in the recirculation zone. Correlations between the average and the maximum Nusselt numbers and the Reynolds number as well as the average and the maximum Sherwood numbers and the Reynolds number suitable for application to turbine blades are developed. The last part of this study involved the prediction of stalled flow in axial compressor cascades. The performance of the algorithm is analyzed and the results from the present study are compared with the available experimental and computational results. Dissert. Abstr.

N94-31872 Defence Research Establishment Pacific, Victoria (British Columbia).

ULTRASONIC CHARACTERIZATION OF DAMAGE IN A SIMULATED CF-18 COMPOSITE STRUCTURE

K. I. MCRAE, R. D. FINLAYSON, W. R. STURROCK, and D. S. LIESCH Feb. 1993 32 p

(DREP-LN-93-26; DSIS-94-01061; CTN-94-61219) Avail: CASI HC

12 ENGINEERING

A03/MF A01

A simulated CF-18 aircraft door component was constructed and subjected to treatment during manufacturing with the object of inducing damage in the composite material in a known and well-defined manner. The simulated component was then sent to participants in a nondestructive evaluation study. Results are reported for tests conducted with a scanning apparatus and data acquisition system which consisted of three components: ultrasonic transducer and scanner comprising a two-axis scanning frame to which a modified commercial transducer was attached; an acquisition system for ultrasonic data known as Signal Processing Ultrasonic Device (SPUD); and a data analysis and display system (DETECT/NDE) specifically designed to manipulate large three dimensional ultrasonic data sets. A series of five large-area scans was performed, each scan about 52 cm square. A total of eight regions of interest were identified for a more detailed analysis of the delamination damage, seven detailed scans covering a 13-cm square and one covering a 20.8-cm square. It was often possible to identify the probable source of the damage as that resulting from impact or caused by overloading of fasteners. Flaws of all significant dimensions were located and fully characterized using the ultrasonic procedure. Author (CISTI)

N94-32042# Naval Postgraduate School, Monterey, CA. HOTWIRE MEASUREMENTS OF THE TURBULENT FLOW INTO A CASCADE OF CONTROLLED-DIFFUSION COMPRESSOR BLADES M.S. Thesis

BRYCE E. WAKEFIELD Dec. 1993 64 p
(AD-A277297) Avail: CASI HC A04/MF A01

Turbulence measurements near the leading edge of a compressor stator were made in a subsonic cascade wind tunnel with a hotwire system. Using a single hot-film probe, velocity and turbulence distortion data were obtained about the leading edge of the Controlled-Diffusion (CD) blades in order to verify Laser Doppler Velocimetry (LDV) data taken in earlier studies. Measurements were conducted at a Mach number of .25, a Reynolds number of 711,000, and an inlet flow angle of 48 deg. Turbulence profiles obtained in the pitch-wise direction were found to be in good agreement with previous LDV measurements. These data indicated a localized increase in turbulence around the leading edge due to the interaction of the free-shear layer with the inlet turbulence. This free-shear layer extends over the separation bubble, which forms on the suction side of the blades' leading edge. DTIC

N94-32045# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.

ON AN ADAPTATION METHOD FOR DENSE, 2D, C-TYPE GRIDS M.S. Thesis

M. A. VIS Jun. 1993 61 p Prepared in cooperation with National Aerospace Lab.
(W-9321; ETN-94-96182) Avail: CASI HC A04/MF A01

The study of the practical application of an adaptive grid method for high resolution (dense), 2D (two dimensional), C type grids around aerofoils is presented. For testing, the method was applied to the adaptation of a grid used for the simulation of a viscous flow around the RAE2822 aerofoil. The method may be suitable for adapting high resolution grids. ESA

N94-32183# Naval Postgraduate School, Monterey, CA. APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY JOURNAL, VOLUME 9, NUMBER 1, MARCH 1994

Mar. 1994 107 p
(AD-A276753) Avail: CASI HC A06/MF A02

The partial contents of this document include the following: On the Use of Bivariate Spline Interpolation of Slot Data in the Design of Slotted Waveguide Arrays; A Technique for Determining Non-Integer Eigenvalues for Solutions of Ordinary Differential Equations; Antenna Modeling and Characterization of a VLF Airborne Dual Trailing Wire Antenna System; Electromagnetic Scattering from Two-Dimensional Composite Objects; and Use of a Stealth Bound-

ary with Finite Difference Frequency Domain Simulations of Simple Antenna Problems. DTIC

N94-32256# California Univ., Los Angeles. Dept. of Mechanical Aerospace and Nuclear Engineering.

SURFACE BOUNDARY CONDITIONS AND RELATED TECHNICAL ISSUES CONCERNING BURNETT EQUATIONS FOR 2-D HYPERSONIC FLOW Final Technical Report, 15 Nov. 1991 - 14 Nov. 1993

XIAO-LIN ZHONG 14 Jan. 1994 21 p

(Contract F49620-92-J-0090)

(AD-A277322; AFOSR-94-0074TR) Avail: CASI HC A03/MF A01

Research on studying steady and transient rarefied hypersonic flow by using the Burnett equations and developing accurate and efficient numerical methods for both the Navier-Stokes and Burnett equations were conducted in three aspects: (1) A new method of formulating the additional boundary conditions for the Burnett equations was presented. The 2-D Burnett equations with first order slip conditions seem to be able to improve the Navier-Stokes equations in two dimensions in the continuum transition regime, though more validation work is needed for the Burnett equations. (2) The first Burnett solutions for axisymmetric flow have been obtained. (3) The high-order ENO schemes have been used to obtain time-accurate solutions of the Navier-Stokes equations to study the unsteady hypersonic shock-shock interference heating on a cylinder. The results show that the inherent unsteadiness has a strong effect on surface heating rates. The ENO schemes were found to work well for numerical simulations of transient hypersonic flow. DTIC

N94-32366# MetroLaser, Irvine, CA.

PHOTOTHERMAL LASER DEFLECTION, AN INNOVATIVE TECHNIQUE TO MEASURE PARTICLES IN EXHAUSTS Final Report, Aug. 1989 - Feb. 1990

CECIL F. HESS Oct. 1993 48 p

(Contract F08635-89-C-0350)

(AD-A277151; AFESC/ESL-TR-90-16) Avail: CASI HC A03/MF A01

Photothermal Laser Deflection (PLD) is an analytical technique to measure in real-time the mass concentration of particles and gaseous exhaust pollutants in a variety of combustion devices (e.g., gas turbine engines and rockets). PLD uses a pump laser to locally heat the particle or gaseous species, thus changing the refractive index of the surrounding gas to form a thermal lens. A probe laser beam travelling through the thermal lens is temporarily deflected, and the amount of deflection is proportional to the species mass concentration. The experiments and analyses conducted during phase 1 demonstrated the feasibility of PLD in measuring the mass concentration of both soot particles and NO₂ at a repetition rate of 25 Hz. PLD response was linear at soot concentrations from 0.3 to 10 mg/cubic meters at NO₂ concentrations from approximately 6 to 208 ppm. Strategies to measure lower concentrations have been defined and include focusing the probe beam onto the face of the bi-cell detector. The large dynamic range, fast acquisition rate, and ability to measure particulate and gaseous pollutants makes PLD superior to other available methods. DTIC

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GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

N94-30602# Midwest Research Inst., Golden, CO.

INTERNATIONAL COLLABORATIVE RESEARCH IN WIND TURBINE ROTOR AERODYNAMICS

D. A. SIMMS and C. P. BUTTERFIELD Dec. 1993 4 p Presented at the 13th Energy-Sources Technology Conference and Exhibition

(ETCE) on Wind Energy, New Orleans, LA, 23-26 Jan. 1994 (Contract DE-AC02-83CH-10093) (DE94-000244; NREL/TP-441-5810; CONF-940113-6) Avail: CASI HC A01/MF A01

Five organizations from four countries are collaborating to conduct detailed wind turbine aerodynamic test programs. Fullscale atmospheric testing will be conducted on turbines configured to measure aerodynamic forces on rotating airfoils. The purpose of these test programs is to come to a better understanding of the steady and unsteady aerodynamic behavior of wind turbine rotors, and provide information needed to build accurate aerodynamic models for design codes. Stall, dynamic inflow, yaw conditions, and tower effects all contribute to unknown aerodynamic responses. These unknown responses make it extremely difficult to produce cost-effective wind turbine designs. Turbines behave unexpectedly, experiencing power surges and higher fatigue loads than predicted. In order to evolve state-of-the-art wind turbine designs, these aerodynamic effects must be quantified and understood. This paper describes a coordinated international research effort that is underway to accelerate this key research area, and help develop a more thorough understanding of wind turbine aerodynamics. DOE

N94-30945# Aeronautical Research Inst. of Sweden, Stockholm. **THE EXECUTION OF WIND ENERGY PROJECTS 1986 - 1992 BETWEEN CHINA AERODYNAMICS RESEARCH AND DEVELOPMENT CENTRE (CARD) AND THE AERONAUTICAL RESEARCH INSTITUTE OF SWEDEN (FFA)** HE DEXIN and SVEN-ERIK THOR Jun. 1993 35 p Sponsored by Swedish Board for Industrial and Technical Development (FFA-TN-1993-19; ETN-94-95856) Avail: CASI HC A03/MF A01

The execution of the first phase agreement on wind energy projects, covering the period from 1986 to 1992, is summarized. The following are addressed: wind tunnel tests of a 2.2 m and 2.8 m diameter turbine, a 5.35 m turbine in stationary yaw operation, pressure measurements, wall interference correction, a 5.35 m diameter turbine under yaw control, visualization of the flow on the rotating blade. It was concluded that the yaw characteristics (including aerodynamic performance and control characteristics) and three dimensional flow of the wind turbine chosen as cooperation items have significant engineering application background and academic value. The results are applicable for medium as well as large size wind turbines and has a positive effect on the development of wind energy technology. ESA

N94-30946# Aeronautical Research Inst. of Sweden, Stockholm. **WIND TUNNEL TESTS OF A 5.3 M DIAMETER YAW CONTROLLED TURBINE** ESKIL ULEN Sep. 1993 130 p Sponsored by Swedish Board for Industrial and Technical Development Prepared in cooperation with Chinese Aerodynamic Research and Development Center (FFA-TN-1993-20; ETN-94-95857) Avail: CASI HC A07/MF A02

In order to meet the need for accurate wind turbine operating data from a variety of situations, a wind turbine was designed, built and tested. A description of the equipment and test results are given from a control point of view. The intention of the tests was to get a better understanding of the performance of a wind power station which from a system point of view is characterized by: two blades with fixed pitch angle, variable speed, yaw control of max rotor speed, hub with teeter, and induction generator. Some tests in stall region were also included. The intention was to get practical experiences by performing tests in a wind tunnel as realistically as possible. Of special interest are the following points: the load and aerodynamic torque of the blades with realistic values of rotor speed and yaw rate and angles; magnitude of teeter angle under yaw control; the required yaw motor torque; the coupling between yaw movements and tower lateral resonance ('fish tail' movement); disturbances, especially around yaw axis caused by blade rotation; and the performance of a hub with teeter in stall region. A small complete wind power station with a realistic yaw servo was used. ESA

N94-31611 Technische Univ., Berlin (Germany). Inst. fuer Luft- und Raumfahrt.

THE CONTRIBUTION OF AERONAUTICS AND ASTRONAUTICS TO THE QUALITY OF LIFE ON EARTH [UEBER DEN BEITRAG DER LUFT- UND RAUMFAHRT ZUR LEBENSQUALITAET AUF DER ERDE]

HEINZ-HERMANN KOELLE and MICHAEL MIELKE 1 Aug. 1993 70 p In GERMAN Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (ILR-MITT-283(1993); ETN-94-95745) Avail: CASI HC A04

A century of aviation and four decades of space flight and their respective developments in the 20th century are considered. The contributions of aeronautics and astronautics with respect to improving the quality of life on Earth are projected for the 21st century by analyzing the potential of the respective technologies to the individual elements comprising a formal goal system defining the 'quality of life'. The individual fields of specific activities as well as individual projects, are evaluated with respect to their potential contributions during the next hundred years. The results obtained are compared with the potential contributions of maritime and surface transportation systems which are considered to form the transportation sector of society. Eight other sectors of society are evaluated in the same manner to allow a comparison of their contributions with the transportation sector in general, and the contributions of the fields of aeronautics and astronautics in particular. ESA

N94-32214 Colorado Univ., Boulder. **THE EFFECTS OF ALTIMETER SAMPLING CHARACTERISTICS: SOME GEOSAT EXAMPLES** Final Report

MICHAEL E. PARKE and GEORGE BORN 20 Jan. 1994 29 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (Contract N00014-92-J-6004) (AD-A276899; NRL-CR/7320-93-0004) Avail: CASI HC A03

Altimetric satellites have characteristic sampling patterns in both space and time. This paper looks at the distortions of oceanographic and atmospheric signals as seen in geosat altimeter data. Because of the pattern of ground tracks laid down by Geosat, measurements of oceanographic and atmospheric phenomena can be distorted spatially as well as temporally. As a result, phenomena measured by altimetric measurements can appear as propagating waves with both wavelength and wavenumber different from the original phenomena. These changes, if not understood, can result in misinterpretation of results from altimeter data. Also, in some parts of the world, distorted signals satisfy the dispersion relation of other oceanographic waves, or two phenomena can both have the same distorted dispersion relations. A paper describing the results of this research is in preparation and will be submitted to the Journal of Geophysical Research Oceans. DTIC

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MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

N94-30572# Carnegie-Mellon Univ., Pittsburgh, PA. **AUTOMATION FOR NONDESTRUCTIVE INSPECTION OF AIRCRAFT**

M. W. SIEGEL In NASA. Johnson Space Center, Conference on Intelligent Robotics in Field, Factory, Service, and Space (CIRFFSS 1994), Volume 1 p 367-377 Mar. 1994 (Contract MDA972-92-J-1010) (AIAA PAPER 94-1223-CP) Avail: CASI HC A03/MF A04

We discuss the motivation and an architectural framework for using small mobile robots as automated aids to operators of nondestructive inspection (NDI) equipment. We review the need for aircraft skin inspection, and identify the constraints in commercial airlines operations that make small mobile robots the most attractive alternative for automated aids for NDI procedures. We describe the design and performance of the robot (ANDI) that we designed, built, and are testing for deployment of eddy current probes in prescribed commercial aircraft inspections. We discuss recent work aimed at also providing robotic aids for visual inspection. Author

N94-30574* Mercer Univ., Macon, GA. Mercer Engineering Research Center.

THE AUTOMATED AIRCRAFT REWORK SYSTEM (AARS): A SYSTEM INTEGRATION APPROACH

MICHAEL J. BENOIT In NASA. Johnson Space Center, Conference on Intelligent Robotics in Field, Factory, Service, and Space (CIRFFSS 1994), Volume 1 p 381-392 Mar. 1994 (AIAA PAPER 94-1225-CP) Avail: CASI HC A03/MF A04

The Mercer Engineering Research Center (MERC), under contract to the United States Air Force (USAF) since 1989, has been actively involved in providing the Warner Robins Air Logistics Center (WR-ALC) with a robotic workcell designed to perform rework automated defastening and hole location/transfer operations on F-15 wings. This paper describes the activities required to develop and implement this workcell, known as the Automated Aircraft Rework System (AARS). AARS is scheduled to be completely installed and in operation at WRALC by September 1994. Author

N94-30575* Environmental Research Inst. of Michigan, Ann Arbor.

AUTOMATED INSPECTION OF TURBINE BLADES: CHALLENGES AND OPPORTUNITIES

MANISH MEHTA, JOSEPH C. MARRON, ROBERT E. SAMPSON, and GEORGE M. PEACE In NASA. Johnson Space Center, Conference on Intelligent Robotics in Field, Factory, Service, and Space (CIRFFSS 1994), Volume 1 p 393-398 Mar. 1994 (AIAA PAPER 94-1226-CP) Avail: CASI HC A02/MF A04

Current inspection methods for complex shapes and contours exemplified by aircraft engine turbine blades are expensive, time-consuming and labor intensive. The logistics support of new manufacturing paradigms such as integrated product-process development (IPPD) for current and future engine technology development necessitates high speed, automated inspection of forged and cast jet engine blades, combined with a capability of retaining and retrieving metrology data for process improvements upstream (designer-level) and downstream (end-user facilities) at commercial and military installations. The paper presents the opportunities emerging from a feasibility study conducted using 3-D holographic laser radar in blade inspection. Requisite developments in computing technologies for systems integration of blade inspection in production are also discussed. Author

N94-31842 Maryland Univ., College Park.

SAFE NAVIGATION AND ACTIVE VISION FOR AUTONOMOUS VEHICLES: A PURPOSEFUL AND DIRECT SOLUTION Ph.D. Thesis

GIN-SHU YOUNG 1993 191 p

Avail: Univ. Microfilms Order No. DA9327522

Two capabilities strongly desired in the operation of autonomous vehicles are safe navigation and active vision. It is a challenge to develop autonomous vehicles capable of operating in complicated, unpredictable, and hazardous environments. To navigate autonomous vehicles safely, obstacles such as protrusions, depressions, and steep terrains must be discriminated from terrain before any path planning and obstacle avoidance activity is undertaken. In the first part of the dissertation, a purposeful and direct approach to obstacle detection for safe navigation has been developed. The method finds obstacles in a two dimensional image-based space, as opposed to three dimensional reconstructed space, using optical flow. The theory derives from new visual linear invariants based on

optical flow. Employing the linear invariance property, obstacles can be directly detected by using a reference flow line obtained from measured optical flow. The main features of this approach are that two dimensional visual information (i.e., optical flow) is directly used to detect obstacles and no range, three dimensional motion, or three dimensional scene geometry is recovered; the method of finding protrusions and depressions is valid for the vehicle (or camera) undergoing general six degree of freedom motion; and the error sources involved are reduced to a minimum, since the only information required is one component of optical flow. A number of experiments from both synthetic and real image data suggest that the approach is effective and robust. The method is demonstrated on both ground and air vehicles. To enhance the capability of active vision, the computer controlled camera system must be calibrated. In the second part of this dissertation, a purposeful and direct method for the calibration of the camera system is developed. The method calibrates all the joint poses and link frames of the manipulator and the camera poses related to the same world frame. The solution for the manipulator, camera-to-manipulator, and base-to-world calibration is developed in closed form. The main features of this technique are that only the form of one equation solving one parameter is used and the camera-to-manipulator and base-to-world calibration are the by-products of the manipulator calibration procedure.

Dissert. Abstr.

N94-31966 Carnegie-Mellon Univ., Pittsburgh, PA.
LARGE-SCALE SHAPE OPTIMIZATION: NUMERICAL METHODS, PARALLEL ALGORITHMS, AND APPLICATIONS TO AERODYNAMIC DESIGN Ph.D. Thesis
CARLOS EDUARDO OROZCO 1993 150 p
Avail: Univ. Microfilms Order No. DA9322751

Motivated by flight vehicle design problems, this work focuses on large-scale optimization problems in which the design variables are parameters describing shape. It deals with several Sequential Quadratic Programming methods that can be used to advantage for the solution of shape optimization problems that involve systems governed by nonlinear partial differential equations. Its main contribution is the development of a family of Coordinate Basis Infeasible Path (CBIP) optimization methods and its implementation in highly parallel architectures. The methods avoid the solution of the discretized form of the state equations at each design iteration by embedding them as equality constraints in the optimization problem. CBIP methods make use of a decomposition into nonorthogonal subspaces that exploits Jacobian and Hessian sparsity in an optimal fashion. In the absence of a line search, the resulting algorithms require the solution of just two or three linear systems per optimization iteration. They are therefore more efficient than traditional path-following methods which typically require many stiffness matrix solves to fully converge the nonlinear state equations at each optimization iteration. In the massively parallel implementation, the construction and solution of the algebraic systems is performed in parallel, as are sensitivity computations associated with the state variables. Parallelism is thus extended to computation of the gradient of the objective function with respect to the state variables, the Lagrange multipliers, the gradient of the state equations with respect to the design variables, and the projected gradient. The parallel optimization algorithms require no additional communication routines nor parallel data structures beyond those needed for the parallel solution of the state equations. The algorithms are applied to a two dimensional aerodynamic design problem, that of determining the shape of an airfoil which produces a desired pressure distribution in the presence of compressible potential flow. Shape optimization problems of up to 90 shape variables, 8,316 state variables, and 16,264 finite elements are solved. The parallel efficiency of the algorithms, i.e., the portion of time spent on parallel tasks relative to the overall time, is high, and they scale well, for a practical number of design variables. Dissert. Abstr.

N94-32093 Dayton Univ., OH. Research Inst.
VISUAL EVALUATION OF COMPUTER-GENERATED TEXTURES

Final Report, Oct. 1990 - Mar. 1993

GEORGE A. GERI, DON R. LYON, and YEHOASHUA Y. ZEEVI Jan. 1994 42 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (Contract F33615-90-C-0005) (AD-A277201; AL/HR-TR-1993-0189) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

Textures generated by superimposing sinusoidal luminance distributions can be used to simulate the natural terrain textures often used in flight simulator imagery. Since the visual system is spatially inhomogeneous with the periphery being generally less sensitive than the center of the visual field, simpler, more easily generated textures can potentially be used to simulate terrain that is farther from the operator's point of regard. The minimal number of component sinusoids required to generate textures that are visually acceptable in the visual periphery was estimated for the discrimination of complex suprathreshold textures. Specifically, similarity ratings were obtained to determine the effects of component orientation and component phase-bandwidth on the cortical magnification factor (CMF) associated with that discrimination. The textures were designed to be both specifically by a relatively small number of localized spectral components and sufficiently complex to approximate natural images. The number of component orientations was found to be a particularly important determinant of texture discrimination in that its effect on rated similarity was largely independent of the total number of components making up the texture. When the number of components was varied, a CMF of 2 was sufficient to equate the similarity ratings obtained at 0.75 deg and 20 deg. Under the same conditions, a CMF of 4 clearly overcorrected the data. The estimated CMF for texture discrimination is much smaller than that found for the discrimination of simple 2-D spatial frequency and suggests that either quantitatively different cortical mechanisms or different cortical areas are responsible for the two types of discrimination. DTIC

N94-32219 Virginia Center of Excellence for Software Reuse and Technology Transfer, Herndon.

MULTIGRAPH: AN ARCHITECTURE FOR MODEL-BASED PROGRAMMING. MODEL-BASED PROGRAM SYNTHESIS FOR PARALLEL COMPUTING. PREMOS: PROGRAMMING ENVIRONMENT FOR MODEL-BASED PROGRAM SYNTHESIS, VERSION 01.00.00

JANOS SZTIPANOVITS, BEN ABBOTT, and HUBERTUS FRANKE Mar. 1994 59 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (Contract MDA972-92-J-1018) (AD-A276949; SPC-93154-CMC) Avail: CASI HC A04/MF A01

This presentation consists of three presentations related to model-based software synthesis. The first presentation provides an overview of the MULTIGRAPH Architecture (MGA), which is used as a generic framework for model-based programming. Evolution of the architecture has been driven by the requirements of specific applications. Characteristics of these application domains and their impact on the basic design of MGA are discussed. The second presentation discusses Model-Based Program Synthesis for Parallel Computing. Automatic program synthesis is one of the prime disciplines that can contribute to the advancement of the software engineering of reactive systems. A large, high-performance parallel instrumentation system used for analysis of turbine engine strain gauge signals produced during altitude testing is presented as an illustration. The system is called the Computer Assisted Dynamic Data Analysis and Monitoring System (CADDMAS). The third presentation discusses a Programming Environment for Model-Based Program Synthesis. The development of model-based programming environments is driven by two opposite forces: specialization and Standardization. The presentation addresses the design and implementation of tools which satisfy both above-mentioned forces. In order to overcome this dilemma, the MULTIGRAPH Architecture uses meta-tools. This presentation focuses on the design and

implementation of meta-tools and their coordination to form a harmonic environment. DTIC

N94-32281# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

UNDERGRADUATE ROBOTICS PROJECTS IN SUPPORT OF RESEARCH ON NEURAL NETWORKS Final Report, 15 Jan. - 15 Jul. 1993

CHRISTOPHER ATKESON 15 Jul. 1993 3 p

(Contract F49620-93-1-0104)

(AD-A277331; AFOSR-94-0088TR) Avail: CASI HC A01/MF A01

This grant was successful both in developing sensor systems and in educating undergraduate students. There were several reasons to ask students to develop these systems. First and foremost is the educational value of having a student build a complete system. This challenge is much greater than a typical course laboratory experiment. The student must propose, refine, and choose among different variants of any particular approach. The system must be designed, built, debugged, documented, and, most importantly, evaluated. Any particular version of the system may suggest future revisions or new approaches. In some cases there are commercially available systems the researchers could use, but in many cases they had trouble finding off the shelf systems that are light and inexpensive enough to suit their purposes. DTIC

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PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

N94-30804 Pennsylvania State Univ., University Park.

EXPERIMENTS ON THE AERODYNAMIC GENERATION OF NOISE IN CENTRIFUGAL TURBOMACHINERY Ph.D. Thesis

PAUL HENRY BENT 1993 299 p

Avail: Univ. Microfilms Order No. DA9326811

An experimental investigation has been made to identify the aerodynamic sources of noise in centrifugal turbomachinery. Emphasis was placed on the generation of noise at frequencies other than the blade passage frequency and harmonics. Experiments were performed on a centrifugal water pump impeller with seven highly backswept blades running in air. Identification of the acoustic sources was made by measurement of the mean and unsteady flow fields and the radiated noise. Two distinct noise generation mechanisms have been identified. The first is the interaction of the impeller with a highly coherent fluid dynamic instability pattern that forms in the discharge of the impeller. This rotating diffuser stall-like instability pattern rotates around the impeller at a fraction of the impeller speed and is comprised of a series of distinct azimuthal modes. The flow field associated with these modes has been modelled as a rotating vorticity sheet of sinusoidally varying strength. It is hypothesized that due to a potential flow type of interaction, the discharge instability pattern causes the loading on the impeller blades to fluctuate and generate noise. Noise generated by this mechanism is narrow-band in character and occurs at frequencies proportional to the relative rotational speed of the discharge instability and the impeller. Significant constructive interference of the sound occurs when the azimuthal mode order is equal to an integer multiple of the number of impeller blades. The second noise generation mechanism is scattering of sound by the interaction of the discharge flow field turbulence with the trailing edges of the impeller blades. The turbulence convecting in the impeller discharge was found to be comprised of a broad range of length scales. To varying degrees,

depending on flow rate, the pressure field associated with the discharge turbulence retains some coherence between the surfaces of adjacent impeller blades close to the trailing edge. When the turbulence is coherent, the resulting noise spectra are comprised of a series of harmonically related broad humps. The turbulent length scales corresponding to the center frequencies of the humps in the noise spectra are equal to integer fractions of the blade spacing. Dissert. Abstr.

N94-31090 Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Applied Acoustics.

A PILOT STUDY OF COMFORT CRITERIA AND SOUND QUALITY METRICS FOR SOUND INSIDE CABINS OF PROPELLER-DRIVEN AIRCRAFT

MENDEL KLEINER Mar. 1993 49 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (Contract NUTEK-92-05162P) (ISSN 0283-832X) (CTH-F-93-03; ETN-94-95948) Avail: Issuing Activity (European Space Agency (ESA))

A pilot study on comfort criteria and sound quality metrics for aircraft interior cabin sound due to propeller and aerodynamic noise is presented. Literature searches on these subjects were made using various international data bases. Several suggested metrics are reviewed. Some results using aircraft sound data are reported. Using a personal computer based system with a signal acquisition/replay board and commercial software it was possible to successfully change the sound quality of recorded propeller aircraft noise signals in several ways. An audio demonstration tape of some of these test signals is available in R-DAT format. A strategy for work in the fields of metrics, sound comfort and sound quality for aircraft interior cabin sound is outlined. Currently available software and hardware for sound quality work are reviewed and short summaries of a number of related articles and papers are featured. ESA

N94-31336* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

INVESTIGATION OF SONIC BOOM FOR THE SPACE SHUTTLE: HIGH CROSS-RANGE ORBITER

RAYMOND M. HICKS, JOEL P. MENDOZA, and LIONEL L. LEVY, JR. 1993 12 p (NASA-TM-108238; NAS 1.15:108238) Avail: CASI HC A03/MF A01

Recent studies of a proposed low cross-range straight-wing space shuttle orbiter have shown that the sonic boom created during reentry may be objectionable, particularly at low supersonic Mach number. Because of this, additional tests have been conducted to determine the sonic-boom overpressure for a blended wing-body shape proposed for use as a high cross-range shuttle orbiter. Two mission profiles, in which a constant angle of attack was held during the supersonic portion of the flight, were studied. In one case the angle of attack was 60 degrees; in the other 25 degrees. The sonic-boom pressure signatures were measured in a wind tunnel and used to estimate overpressures for both missions. A technique for alleviating the boom is indicated. Author (revised)

N94-31337* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

INVESTIGATION OF SONIC BOOM FOR THE SPACE SHUTTLE: LOW CROSS-RANGE ORBITER

LIONEL L. LEVY, JR., RAYMOND M. HICKS, and JOEL P. MENDOZA 1993 10 p (NASA-TM-108237; NAS 1.15:108237) Avail: CASI HC A02/MF A01

It is desired that the Space Shuttle Orbiter be capable of landing at airports equipped to handle present-day jet transports. Since the majority of such airports are located near heavily populated areas, an investigation has been undertaken to determine whether or not the sonic boom generated during reentry of Space Shuttle Orbiters is potentially a serious problem. The investigation was concerned with the low cross-range orbiter and reentry concept

proposed by Faget of the Manned Spacecraft Center (MSC). This report describes the approach used and presents the results obtained to date. Author (revised)

N94-31846 Notre Dame Univ., IN.

EXPERIMENTAL AND COMPUTATIONAL STUDIES ON PROPELLER NOISE DUE TO INFLOW DISTORTION Ph.D. Thesis

SRINIVASAN SUBRAMANIAN 1993 298 p Avail: Univ. Microfilms Order No. DA9320189

Large-scale non-uniformities in the approach flow to a propeller result in periodic unsteady blade forces that radiate tonal noise at the blade passing frequencies and its higher harmonics. The current research focuses on a combined theoretical and experimental approach to study this propeller aeroacoustic problem. The theoretical study employs the classical acoustic analogy in conjunction with two-dimensional unsteady aerodynamic theory. The experimental side of this research is conducted in an anechoic flow facility and employs a four-bladed marine propeller. Both isolated and cyclical distortions are investigated. The radiative properties due to isolated distortions is first studied by operating the propeller behind the wake of a rod. Qualitative comparisons of the measured directivities match well with the analyses from theory. Next, the analysis is extended to cyclical distortions in the incoming flow. The theoretical analysis accounts for the effect of mean blade loading on the unsteady blade forces and provides an upper and lower bound for the resulting far field noise radiation. The experimental study employs non-uniform flow generators that provide a three-cycle and four-cycle azimuthal variation in the approach flow. An extensive comparison of the measured noise levels with the theoretical predictions shows an excellent agreement both in magnitude and directivity. Dissert. Abstr.

N94-32043# Naval Postgraduate School, Monterey, CA.

HEAT TRANSFER STUDIES ON A RECTANGULAR CHANNEL WITH OFFSET PLATE FINS M.S. Thesis

JEFFREY M. MASTERSON Dec. 1993 49 p (AD-A277300) Avail: CASI HC A03/MF A01

Convective heat transfer characteristics of a liquid cooled rectangular channel, containing offset plate fins, were investigated experimentally. The selected geometry was a 10x model of the fluid circulation passages in the commercially available SEM-E type electronic cooling modules. The test surface containing fins was made of aluminum and was heated at its base by a thermofilm heater. The Reynolds numbers were varied between 100-800, with water as the cooling fluid. Surface temperature measurements on the heated surface were used to determine the Colburn j factor. The effects of natural convection were also investigated. DTIC

N94-32418# Federal Aviation Administration, Cambridge, MA.

HELIPORT NOISE MODEL (HNM) VERSION 2.2 (USER'S GUIDE) Final Report, Oct. 1989 - Feb. 1994

GREGG G. FLEMING and EDWARD J. RICKLEY 23 May 1994 91 p (AD-A277072; DOT-VNTSC-FAA-94-3; DOT/FAA/EE-94-01) Avail: CASI HC A05/MF A01

The John A. Volpe National Transportation Systems Center (Volpe Center), in support of the Federal Aviation Administration, Office of Environment and Energy, has developed Version 2.2 of the Heliport Noise Model (HNM). The HNM is a computer program used for determining the impact of helicopter noise in the vicinity of terminal operations. This document, prepared by the Volpe Center's Acoustics Facility, is a User's Guide for HNM Version 2.2. It presents: (1) computer system requirements and installation procedures; (2) an overview of HNM capabilities and the user's implementation of these capabilities; (3) the elements of a heliport case study; (4) a step-by-step tutorial for preparing and running a case study; and (5) the interpretation of HNM Version 2.2 output. Also presented, in the Appendices of this document, are the following: (1) a discussion of the technical revisions made to several internal algorithms - primarily revisions which are transparent to HNM users;

(2) a discussion of the helicopter noise Data Base used by the HNM; and (3) a summary of error messages in the HNM. DTIC

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SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

N94-31732# Concordia Univ., Loyola Campus, Montreal (Quebec). Dept. of Geography, Public Policy and Public Administration Program.

COMMON PROPERTY RESOURCES AND LOW-LEVEL FLYING IN LABRADOR: FLIGHT, FIGHT OR FANCY? M.A. Thesis

SHERRI LABOUR Sep. 1993 112 p

(ISBN-0-315-87318-3; CTN-94-61240) Copyright Avail: Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

Modern, low-level training flights have been conducted out of the air base at Goose Bay, Labrador since the early 1980s. The flying season is restricted to seven months a year (April to November) over two flight training areas totalling 99,000 square km. The flights usually last 60-90 minutes, often consist of two planes flying in formation, and may come as close as 30 m to the ground. Aboriginal groups have protested against these flights because of their possible effect on the environment and on native life styles based on a hunting and fishing economy. A study is presented which illustrates how the fundamentally different attitudes and values that Euro-Canadians and aboriginals attach to land are at the core of the conflict over low-level flying in Labrador. It is shown how common property resource management strategies can mediate the contrasting attitudes and values of the aboriginals and the Canadian Defence Department with respect to land and nature. Emphasis is placed on understanding the human side of the problem and the personal and political concerns of the people involved in the conflict.

Author (CISTI)

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SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.

N94-31709# Royal Military Coll. of Canada, Kingston (Ontario). **NEUTRON MEASUREMENTS AT THE COMMERCIAL AIRCRAFT ALTITUDES M.S. Thesis**

RICHARD KOSIERB Apr. 1993 207 p

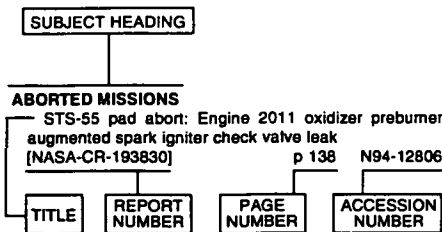
(ISBN-0-315-86201-7; CTN-94-61185) Copyright Avail: Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

To provide more complete information of the neutron component of the galactic cosmic ray field at aircraft altitudes, an investigation was conducted in which a group of Air Canada and Air France pilots routinely carried neutron bubble detectors on their normal flight duties for a period of about one year. Each pilot carried one dosimeter, activating it on takeoff and resetting it on landing. A data base of over 600 flights was obtained. This work yielded measurements of the fast neutron flux of 1.436 to 2.259 neutrons per square cm per second (ncms) for the Air Canada and 2.033 to 2.909 ncms for the Air France flights. In addition, the pilots typically experienced an annual total dose equivalent (including neutrons and gamma

rays) of 3.1 to 3.9 millisieverts per year. These results are found to be in agreement with other experimental and theoretical work. Consequently, the total dose equivalent experienced by the air crew is clearly above the new recommended dose limit of one millisievert per year for the general public, which would classify the flight crews in the same category as an atomic radiation worker.

Author (CISTI)

Typical Subject Index Listing



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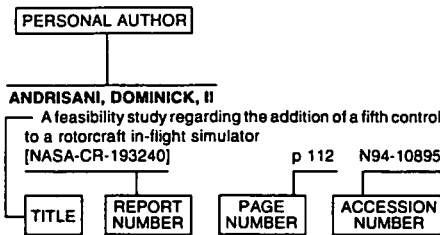
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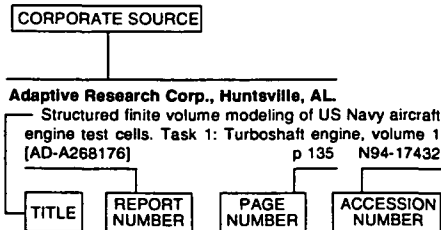
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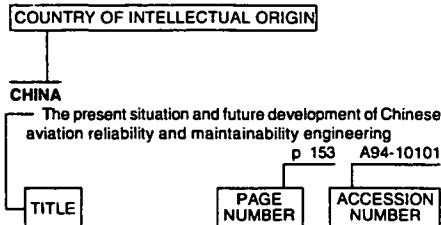
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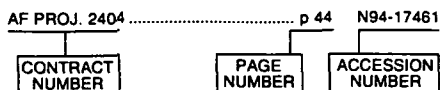
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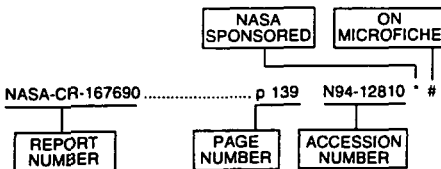
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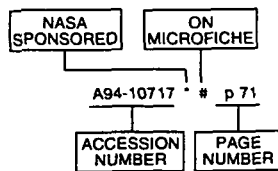
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AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 306)

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REPORT DOCUMENT PAGE

1. Report No. NASA SP-7037 (306)	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Aeronautical Engineering A Continuing Bibliography (Supplement 306)		5. Report Date July 1994	
		6. Performing Organization Code JTT	
7. Author(s)		8. Performing Organization Report No.	
		10. Work Unit No.	
9. Performing Organization Name and Address NASA Scientific and Technical Information Program		11. Contract or Grant No.	
		13. Type of Report and Period Covered Special Publication	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546-0001		14. Sponsoring Agency Code	
		15. Supplementary Notes	
16. Abstract This report lists 181 reports, articles and other documents recently announced in the NASA STI Database.			
17. Key Words (Suggested by Author(s)) Aeronautical Engineering Aeronautics Bibliographies		18. Distribution Statement Unclassified - Unlimited Subject Category - 01	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 84	22. Price A05/HC

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Ruston, LA 71270-9985
(318) 257-4962 Fax: (318) 257-2447

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Minneapolis, MN 55455
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UNIV. OF MISSISSIPPI

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University, MS 38677
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(402) 472-2562

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Albuquerque, NM 87131-1466
(505) 277-5441 Fax: (505) 277-6019

NEW MEXICO STATE LIBRARY

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Santa Fe, NM 87503
(505) 827-3826 Fax: (505) 827-3820

NEW YORK

NEW YORK STATE LIBRARY

Documents/Gift & Exchange Section
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Cultural Education Center
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NORTH CAROLINA

UNIV. OF NORTH CAROLINA -

CHAPEL HILL
CB#3912, Davis Library
BA/SS Dept. - Documents
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(919) 962-1151 Fax: (919) 962-0484

NORTH DAKOTA

NORTH DAKOTA STATE UNIV. LIB.

Documents Office
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STATE LIBRARY OF OHIO

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Fax: (405) 525-7804

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Stillwater, OK 74078
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Public Documents Unit
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Columbia

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Austin, TX 78711
(512) 463-5455 Fax: (512) 463-5436

TEXAS TECH. UNIV. LIBRARY

Documents Dept.
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(806) 742-2268 Fax: (806) 742-1920

UTAH

UTAH STATE UNIV.

Merrill Library & Learning Resources
Center, UMC-3000
Documents Dept.
Logan, UT 84322-3000
(801) 750-2684 Fax: (801) 750-2677

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UNIV. OF VIRGINIA

Alderman Library
Govt. Documents
Charlottesville, VA 22903-2498
(804) 824-3133 Fax: (804) 924-4337

WASHINGTON

WASHINGTON STATE LIBRARY

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Morgantown, WV 26506
(304) 293-3640

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ST. HIST. SOC. OF WISCONSIN LIBRARY

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Madison, WI 53706
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In cooperation with Univ. of Wisconsin -
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